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ANNOUNCEMENTS.

FEILDEN'S MAGAZINE is published on the *first* of every month.

In consequence of the large number of pages to be prepared and passed for press, the careful nature of the printing required for high-class production, the advance arrangements made for extensive circulation, and in order to facilitate departmental business, observance of the following rules is necessary:—

Literary Matter to reach the offices not later than the 15th of the month (as much earlier as possible) previous to date of publication. Communications to be addressed "Editorial Department."

Advertisements intended for insertion in next issue must be received not later than the 15th of the month (as much earlier as possible), to insure correct classification. All communications respecting same to be marked "Business Department." Advertising Rates, on application, regulated according to positions available.

Subscriptions and letters with reference to copies to be marked "Subscription Department."

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For Buyers' Guide, Index to Advertisers, and Directory of leading British Manufacturers, see page ii. of second cover, and pages iii. to xiii. (in first part of Magazine).

All communications to be addressed
FEILDEN MAGAZINE CO.,
Temple Chambers, Embankment, London, E.C.

LIST OF CONTRIBUTORS.

The next and succeeding issues of FEILDEN'S MAGAZINE will contain articles specially contributed by, among others, the following distinguished writers, on subjects which they have made their own:—

Sir A. SEALE HASLAM
Prof. ROBT. H. SMITH, M.I.M.E.
Prof. JOHN GOODMAN, M.I.C.E.
Prof. A. C. ELLIOTT, D.SC., M.I.C.E.
Sir EDWARD J. REED, K.C.B., F.R.S.
Sir WILLIAM WHITE, K.C.B., LL.D., F.R.S.
Dr. FRANCIS ELGAR
Prof. W. H. WATKINSON, M.I.M.E.
Prof. W. E. AYRTON, F.R.S.
C. F. CROSS, F.C.S.
W. N. TWELVETREES, M.I.M.E.
W. FLETCHER, M.I.M.E.
Sir EDMUND VERNEY
HIRAM S. MAXIM
C. E. SPAGNOLETTI, M.I.C.E.
J. I. THORNYCROFT, F.R.S.
Dr. J. C. THRESH
C. KOUS-MARTEN
EWART C. AMOS, M.I.M.E.
Prof. VIVIAN B. LEWES, F.I.C., F.C.S.
A. R. BENNETT, M.I.E.E.
Prof. ROBT. BEAUMONT &c., &c., &c.

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NOTE:—Owing to the exceptional demand for our first issue—necessitating a large reprint—and the increased number of copies of No. 2 to be printed, this issue is published on the 6th inst.

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"Feilden's Magazine

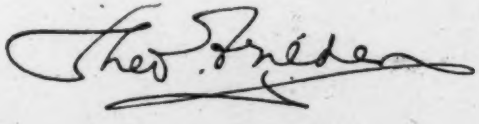
is undoubtedly the greatest success ever recorded in Engineering journalism. It has leapt into the front place at a bound."

The words are not mine, but were spoken by one of the most eminent authorities in the United Kingdom, and they represent the feeling in industrial-engineering circles throughout the length and breadth of the land.

It is gratifying, more than gratifying, to be able to state that the publication of the first issue elicited support and congratulations exceeding even my most sanguine expectations. The result is a complete justification of my programme, and unmistakeably demonstrates that such a journal was wanted. The supporters of the Magazine already present a remarkable list, embracing well-known men and representative firms in the engineering and cognate industries in all portions of the three Kingdoms, whilst indications are strongly in evidence that traders throughout the world, particularly in our Colonies, are showing a similar appreciation.

It is equally satisfactory to add, that the advent of this publication has met with the unanimous approval of the British daily press, and its advertising supporters will be pleased to learn that over *ten thousand* copies of No. 1 were bespoken within forty-eight hours of publication, necessitating the reprinting of the Magazine; a precedent in trade journal annals. I think it is as well to state that this demand shows no indication of being ephemeral; in fact, it is certain that the circulation of No. 2 will exceed that of the first issue, and I have every reason to believe that it will continue to increase.

There was never any doubt in my mind as to the ultimate result of the labours I and my staff have been so long assiduously engaged in. I am nevertheless almost overwhelmed with the result, and I scarcely know how to express my thanks for the generous appreciation that has been accorded me. In placing on record my acknowledgments, I can only add that nothing will be left undone, not only to maintain, but enhance, what I may be pardoned for describing as the superior standard of excellence of my Magazine, in order to reach the high ideal which I have set out to attain. Holding the conviction that I have produced a publication which will make for the increased industrial welfare of our country, I ask with confidence the continued and increased support of all connected with the British engineering industries.



"Militantly British."

In these days of superabundant periodical literature so many magazines and journals come into existence without the faintest pretext to fixity of purpose, or to any rational programme beyond the acquisition of revenue, that it is not at all surprising, and is, indeed, quite in accordance with the fitness of things, that a Magazine like our own, which has avowedly presented itself with all the earnestness of one having a mission to fulfil, should have its *raison d'être* subjected to the severest scrutiny. In only one or two cases has that scrutiny developed controversial aspects, for from all sorts and conditions of readers, from popular, "class" and technical journals, from professional men, manufacturers and all grades of traders, we have received the most abundant measure of encouragement, and the verdict on our initial effort is conclusively favourable. That this is so is indicated by evidence which we publish elsewhere. Even where, as we have suggested, an element of criticism has manifested itself, the asperities of contact have been lubricated with such a *soupçon* of kind allusion to the results of our work as a whole, that we are grateful, rather than otherwise, for the divergencies of view of which our advent has been the occasion. We have been frank in our avowal of policy and procedure, and our motto—"Militantly British"—has exercised some of our leading journals sufficiently to cause them to make the expression, in connection with reviews of our objects, the subject of leading articles in their columns.

We feel flattered by the amount of prominence given to our "war cry," and are surprised at the very trifling differences in opinion between the tenets of our editorial policy as expressed in our initial number and the views of our critics. "Why 'militantly'?" asks the *South Wales Daily News*, for example. "In matters industrial," insists our Cardiff contemporary, "there is but one test of excellence, or at most two: price and quality determine the market position of manufactures, whether of locomotives or bootlaces, for though superior state in marketing may at first win the foremost place, the superior article forges to the front ultimately." That is excellent reasoning so far as it goes, but it rather misses the point. Price and quality are essentially dominating factors in trade, but be the relationship between the two—and it is fatuous to deal with them as being otherwise than allied quantities—ever so legitimately close, there is still lacking the element of initiative force, introduction, insinuating "push," or whatever it may be best described as, which render the equitable association of price and quality of any marketable value. It is in this particular that we are excelled by our competitors, and by our American and German rivals in particular. They first of all study the requirements of a market, and they adapt their machinery, tools, or other productions not only to the immediate requirements of the market, but even to its peculiarities and its eccentricities. On the other hand, we are apt to demand that the market shall meet the convenience of the goods rather than that the goods shall meet the convenience of the market. This absurd idea alone has been a source of unending disaster to our export commerce, and of untold anxiety to our consuls abroad. Our contemporary, again, asks, "Is it to decry the work and wares of the foreigner, and to laud the British product solely because it is British," that we use the term "militantly"? Certainly not. But on the other hand, when we see

markets, originally our own, being successfully exploited by competing nations with goods intrinsically inferior to our own, or at all events not superior to them, as the results of more modern methods of manufacture and more up-to-date methods of business proceeding, we should be sadly wanting in any national feeling if we failed to stir up a militant feeling in order to remedy such a disastrous condition of affairs.

Another journal, the *Newcastle Leader*, objects to our adopting the words "Militantly British" as our indication of policy, because it necessarily espouses the "Imperial idea," which it regards as a "Chauvinistic patriotism" — the antithesis, in short, of an effete cosmopolitanism based originally, and somewhat mistakenly, on the Manchester school. "This 'militantly British' spirit" affords, it remarks, "a narrow, soul-cramping ideal, destructive of those finer impulses and wider ranges of thought which have always been contemporaneous with the best work in the laboratory, and in the engine shop. A militant selfishness, a militant clannishness, and a militant nationalism, all come from one source; and if we search history we shall find that the individuals, the families, the clans, and the nations which have drawn most deeply from this source have not been the leaders of industrial or social progress." We do not admit anything of this kind, and any such assumption is quite opposed to the spirit of those lessons which history has taught *us*. If to encourage our own race to accomplish its best in competition as against other races; to promote with this object the highest standard of efficiency in design, production and ultimate utility; to endeavour for our national benefit, as well as for that of civilisation, to advance the legitimate expansion of our Empire; and to insist upon our trade following, where it does not precede, our flag, is to be "soul-cramping" and "narrow," where, we should ask, does a broad and liberal view of national prosperity come in at all? Those "higher ideals of the despised economists and politicians of the Manchester School," [by the way, when *did* they become despised?] whatever they may be to which our critic alludes, may be all very well as ideals, but the materiality and keenness of international end-of-the-century competition demands something with more backbone than an abstract ideal. If Great Britain, whose industrial reputation throughout the markets of the world is synonymous with all that is honestly substantial and of clean and good report, is not to descend from her high plane and become a second-rate or third-rate producing nation, the decadent system of "masterly inactivity" in our trade concerns must cease, and give place to the only alternative—a "Militantly British" policy.

The Paris Exhibition—and British Exhibitors!

As the result of a systematic enquiry, with which many of our readers will be already familiar, we find that although applications for space at the Paris International Exhibition of 1900 made by some British firms have been cancelled, there is no absolute evidence to show that these have been primarily directly due to the disturbed condition of public affairs in the capital, but to considerations that in some instances have been the subject of rather acrimonious discussion.

The fact is, that the allotment of space, as conducted by the Royal British Commission, has apparently given rise to a certain amount of dissatisfaction. Although

the lists of British Exhibitors have not yet been completed, a scrutiny of those already published is certainly disquieting. We see repeated instances of firms of minor standing being allotted space, presumably to the exclusion of really representative British firms; whilst we can vouch for the fact, incredible though it may appear, that German firms in London dealing solely with German manufactures imported from the Continent will be masquerading at the Exhibition under the guise of British manufacturers.

This is regrettable, and we think that Colonel Jekyll, the head of the Royal Commission, would have been well advised if he had consulted a small committee practically acquainted with the standing of applicants before granting space to them. Many of these allotments, we are sorry to say, are, in our opinion, misplaced.

It is, of course, obvious that this Magazine cannot give expression to political bias. But the fact is patent that of recent years, trade has been more and more becoming a political question. Politics, especially during the past few years, have been exercising a determining influence on trade and commerce, and it is impossible, therefore, for an influential publication of this description to ignore the fact. In this regard, therefore, we feel it our duty to call attention to a matter in connection with the Exhibition which has received hitherto little or no attention. British commercial houses are not of a nervous or impulsive disposition; but it cannot be concealed that the condition of public affairs in France is being regarded by many firms who have committed themselves to preparations for the Exhibition, with apprehension.

We do not say, and, in fact, the information we have collected on the matter does not entitle us to say, that there is at present the least disposition on the part of English firms to immediately withdraw from the Exhibition. They possess—we feel justified in speaking in their name—a firm faith in the good sense of our neighbours, and a conviction, in which we are glad to concur, that the turbulence in the French capital is merely transient, and that everything calculated to disturb the harmony essential to the prosecution of a peaceful enterprise will pass away.

On the other hand, it is equally certain that there are misgivings, and that these misgivings are presumably responsible for a certain lassitude in the preparations for the exhibits. Not a few firms, we believe, are "holding over" their arrangements in the anticipation of better times. We are expecting these; but until they actually arrive, or until at least there is a clear prospect of them, our friends across the Channel must concede that an absence of enthusiasm on our part concerning the Paris Exhibition is both natural and unavoidable.

The Progress in Electro-Chemics.

But a few years ago, electro-chemistry, as the term is now understood, was a mere matter of the laboratory. But with the evolution of the dynamo, what now appears destined to become a main branch of productive manufacture, at once began to develope. Colonel Holland, whose name is less known in electro-chemical science than it deserves to be, was one of the pioneers of this new industry, having an experimental plant in operation for a lengthy period at his works in Kent, long before any particular attention was devoted by either scientists

or capitalists to the subject. At present, the chief interest associated with the electro-chemical industry is that connected with patents, which are being challenged and maintained on several sides. The manufacture of carbide of calcium, for instance, is claimed in this country as a monopoly by one firm that hold the Willson patents for the manufacture of this product, and this claim is being contested by a body of manufacturers who appear to have united their resources against what they evidently consider a common antagonist.

The result of the case when it finally emerges from the Law Courts should be of great importance. Apart from the production of chloride of lime and alkali, the electrolytic production of calcium carbide is now the chief product of the electric current, the demand for the material being so great that the British Aluminium Company, Ld., the proprietors of the famous Foyers Falls, which they have utilised for motive power, have diverted a portion of their plant from the production of aluminium to that of the rival product. One firm on the Continent, alone—the Schuckert Electric Company—have been responsible, during the past two years alone, for the investment of no less than £1,200,000 in works devoted to the production of the carbide; whilst other parts of the old and new worlds are being scoured for natural water-power available for the propulsion of electrical generating plant.

It appears certain that electro-chemical products will take the place of many others now produced in a less simple and more costly manner. The conditions of manufacture in electro-chemical operations are even now attractive and interesting in the highest degree. We are only at the beginning of an industry whose possibilities cannot be gauged at the present with even the remotest approach to accuracy.

Consular Reports.

CONSULAR Reports relative to British trade are issued without notice, at uncertain intervals, and are mostly prepared by gentlemen who have not had the advantage of any practical commercial experience. Some of the Reports, however, are valuable, and struggle to the light of day against great obstacles. The Reports are treated as State Papers, are issued in the regulation blue cover, and can be obtained by payment of a sum which must be first ascertained by an application to the Foreign Office or to the Queen's Printers. Taking the Reports as a whole, they are, with a few exceptions, quite useless, either in consequence of the incompetency of their authors, or from great delay in their publication, rendering the information out of date.

This is the present procedure in this country in a matter which is most vital to its interests. The Reports, when rendered, appear to be furnished more as an act of grace than of duty by the officials who forward them; and, especially of late, have, instead of giving information that might be possibly of value, consisted for the most part of reproving homilies addressed on the subject of their failings to British manufacturers.

That a properly organised commercial section is now a necessity to the Government of a manufacturing country, is shown by both Germany and the United States, whose Consular service in trade respects is incomparably superior to our own. In America, for instance, Consular Reports are issued daily and forwarded at the State expense to the principal newspapers; a procedure whose very

suggestion would horrify our officials in Westminster. That this privilege is appreciated, however, is shown by the fact that American Trade Reports have repeatedly been reprinted from the general press of the United States by technical journals in England. In the practical character of these Reports and the promptitude of their publication, we have never had anything to compare with them.

It is obvious that the control of Consular Reports, so far as they affect trade and commerce, should be taken from the Foreign Office and placed under the superintendence of either a specially organised department, or the Board of Trade itself, which, in the absence of any other, is the natural and proper authority. There should be some system evolved in their publication and promulgation: they should be moderate or even nominal in price, and, above all, they should be prepared by intelligent agents practically acquainted with the trading conditions and characteristics of the country in which they may be stationed, and *published immediately on their receipt.*

The Translation of Catalogues.

We have received on several occasions complaints from manufacturing and exporting firms in this country respecting the difficulty and expense of obtaining adequate translations of their price lists and catalogues for use in foreign countries. Those practically acquainted with export trade will know that there is a real want in this direction. It is true there are a number of firms who profess to make technical translations, and are quite ready to undertake any commissions of the kind. But, speaking broadly, the charges made for work of this kind are usually, mildly speaking, exorbitant, and the manufacturer possesses no security that his work will be properly carried out. That is to say, he has no check that will enable him to verify the exactitude, or gauge the literary style of the translation to which his name will be attached, and for which he will, of course, be himself responsible.

There was at one time a notion that one of the functions of the Imperial Institute would be to supply manufacturers with expert assistance in the preparation of catalogues and price lists in foreign languages, with prices and weights converted into local equivalents. The Imperial Institute, however, does not appear to have made in any period of its chequered existence any particular attempt to fulfil the expectation to which we have referred; and now we suppose that whatever sphere the Institute was supposed to occupy in the industrial economics of the country is definitely closed so far as it is itself concerned.

Many have supposed that the London Chamber of Commerce would have before now taken some decisive step in a matter which none can refuse to admit is one of crying urgency. But, so far as we are aware, that body has not yet done anything whatever in the matter; nor does there appear much probability that it will. Yet it is manifest that some official establishment to which manufacturers could submit their trade literature, with a reasonable certitude of just charges and proper execution, would be of the greatest benefit not only to individual manufacturers, but to the trade of the country at large. We venture to make the suggestion that a translations department allied with, or at least under the control of, the Board of Trade, would not be idle for want of work. It might not be self-supporting. Indeed, the probabilities would be that it would involve some infinitesimal charge on the taxpayer. But the benefits that would result from the establishment of such a centre seem to be tolerably obvious. We should think at least that this want, now being felt more and more, is one that might at least be considered by the authorities who are responsible for the expenditure of large sums in technical education and other purposes in connection with the commerce of the country, that would not be sensibly increased by the addition to which we have referred.

"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilization's timepiece put back 200 years."—Rt. Hon. Lord Charles Beresford, C.B.

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American Engines for Glasgow . . .

The Corporation Tramway Committee of Glasgow have, in their wisdom, just accepted an American tender for the supply of engines to the tune of £114,554. We cannot blame the Committee altogether, as they have to handle other people's money, but the case is an ugly one, and the facts will stand some investigation. The Glasgow Corporation Tramway Committee want engine power to drive their electric plant. They invited tenders in the ordinary way, it seems, and the lowest one for engines of the calibre required was that of a Milwaukie firm. Now from Milwaukie to Glasgow is a very far cry, and the latter city is the centre of what is probably the greatest and most prolific engineering district in Great Britain—perhaps, in the world. To send engines to the City of St. Mungo, seems as heinous an offence against the industrial proprieties as to send coal to Newcastle, or cutlery to Sheffield. The excuse claimed by many eminent authorities for our permitting America to supply our great railways with locomotives has no counter-part in this case, so far as our knowledge and information go. The matter seems to resolve itself entirely into one of price, and this is a very serious consideration for our British engineers. If Milwaukie can supply engines to Glasgow cheaper than Glasgow can provide them for herself, one may well be excused for asking in semi-despair, What next? Could there be a more eye-opening commentary on the objections to the view of our "Militantly British" programme than this very fact? Although we hold that the Glasgow Corporation Tramway Committee are not to blame, it would be interesting to know what are the views of the unsuccessful tenderers on the subject, especially as regards the prevailing conditions which exist in Milwaukie and Glasgow respecting the manufacture and supply of such specialities as are here under consideration.

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The Demand for Motive Power . . .

It is now generally conceded that all forms of energy are convertible, and although in some instances failure has attended the efforts put forward to bring about the conversion, the theory, at any rate, is in no way affected or its correctness questioned. Perhaps one of the most striking instances of this is to be found in electrical forms of energy, as in the dynamo and motor; in the one case the rotation of the armature produces a current of electricity which in the other can be made to produce the rotation of the motor by an inverse process. New forms of this energy are being disclosed to the world continually, and since there is probably but one force behind them all, there is every reason to suppose that it may yet appear in other forms. The demand for motive power, outside that to be found in the human being, is greatly increasing, and will still increase as the world grows older. The tendency of the present age is to do as little as possible ourselves, and to make machinery do it for us. It is admitted, of course, that machinery has first to be constructed, but experience has proved that the output of

a machine far exceeds the labour required in its construction. In what direction, therefore, are we to look for an ideal motive power capable of driving this machinery? We do not refer to the perpetual motion as understood by inventive cranks, but to some form of energy which shall be more universally obtainable than any we know of at present. The chemists, doubtless, hope to find it in their realm of investigation; whilst the electrician looks for a primary battery which shall solve the difficulty. The conversion of dust-refuse into electric light is a step in the right direction, although the loss in transition is very considerable. Here, however, the loss is not a serious matter, as the fuel is not only a waste product, but compensation is obtained in getting rid of what is undesirable and obnoxious. At the same time it may confidently be anticipated that the potential energy existing in the refuse of fuel may find a path along which it can travel in its journey to electric light which shall have fewer obstructions and consequent loss than it has at present. We may take it for granted that in the conversion of energy some loss will be experienced in the transition stage, and the most economical motor is doubtless that which converts the energy most perfectly; but we do not hesitate to express our opinion that a more advantageous form of motive power than anything we have at present yet will be discovered. In the meantime we might perhaps more extensively utilise a form of energy which we have at our disposal, viz., Water Power.

Armour Plate Fractures . . .

The relationship between projectiles on the one hand, and armour plates on the other, is so closely connected with the question of our naval efficiency, that any contribution from an authoritative pen, which tends in any way to advance the sum of knowledge on the technical points involved, will be welcomed by the scientific investigator. The article which we publish elsewhere, by Sir William Roberts-Austen, K.C.B., F.R.S., will, no doubt, serve to open up to many scientific minds a fresh field for inquiry. The general subject of the nature of fractures, especially in armour plates, is not one upon which much certain knowledge prevails. Yet an acquaintance with the minutiæ of, as well as the greater scientific laws governing, fractures, such as occur in armour plates after attack from projectiles, is a matter of the greatest moment in connection with the offensive and defensive efficiency of this or any other country. The subject is necessarily a severely technical one, dealing with one of the refinements of scientific examination, but is also one of fascinating interest to the thoughtful. The scope of the article we publish only enables Sir William Roberts-Austen to deal slenderly with a fertile theme, but the purpose of the paper will have been well served if it causes some degree of increased anxiety to be aroused for the more thorough investigation of what he describes as the "comparatively obscure problems" involved, and which are worthy of much more serious attention at the hands of experts than they have yet received.

Trade 'Wrinkles' from America. . . .

In the course of a voluminous correspondence antecedent to the establishment of this journal, we had opportunities of securing an interchange of opinion on trade subjects with numerous representative firms in this and other countries, on the general subject, in all its manifold phases, of the best means of fostering and developing British industries, and of combating the competition of our rivals. As to the sum total of the result of that correspondence, we confess to some measure of disappointment in the sense that a certain air of apathy seemed to be a governing quantity, and an irritating element of indifference asserted itself where it was least expected. At the same time there was so much that was encouraging forthcoming, alike in opinion and suggestion, that the net result was such as to give a rich stimulus to the efforts we have since made. There was one letter, we remember, which reached

us from a well-known manufacturing establishment in the North of England, containing one or two "wrinkles" as to American methods of pushing trade, which commended themselves to us as likely to be useful in the way of suggestion if quoted. For one thing, it appears that the National Association of Manufacturers of the United States publishes, in the form of a trade index, a descriptive and classified membership directory of the Association, arranged for the convenience of foreign buyers. It gives enough information to put any buyer of almost anything into direct communication with the American manufacturer. Our correspondents wrote: "Suppose we wish to buy bar iron, we find on page 178 of this book the address of 16 manufacturers; if we want to buy typewriter inks, we have the names of two manufacturers; . . . and so on. We can get information about milk jars, jams, jewellery, jute products, ketchup, sugar, kettles—in fact anything we may wish to buy." This is not all. Our correspondents state that they have had a letter from the National Association of Manufacturers, giving them advice about the forwarding of goods from the United States to this country. In the letter the Association officials say: "If when you order goods from the United States you will give instructions to have them shipped through the International Freight and Transportation Co., B19, Produce Exchange, New York City, which is maintained by this Association for the benefit of its members, you will be able to secure the best current rates of freight. This bureau is maintained for the purpose of making shipments for the members of this Association at the least possible cost, and gives all the advantages resulting from careful organisation and the handling of a large volume of freight. You will doubtless find it to your advantage to have your goods shipped through that medium." There is nothing to complain of in all this from the point of view of commercial morality. It is fair trading, and shows a spirit of enterprise and grasp of the international competitive situation which we cannot but admire. But we should like it better if it had its counterpart on this side of the Atlantic. There is, in short, nothing of which American or German initiative is capable, that is calculated, if properly adapted to our national exigencies and to our insular necessities, to be of service to British trade, which British enterprise and capital cannot emulate or surpass. The question is: how long are our traders content to persevere in their old and well-tried methods, which, suited to obsolete conditions, are in many cases absurd when placed alongside of up-to-date requirements? Where, for example, can we point to an institution which fulfils the functions of the National Association of Manufacturers of the United States? We cannot look for it in the direction of our trade associations, or our Chambers of Commerce. Why should our keenest competitors hold a monopoly of devices for the acquirement and assimilation of trade?

The Construction and Equipment of Engineering Works . . .

In the course of a long experience in visiting engineering and industrial establishments, we have frequently been struck with what, in a sense, might be termed the picturesque irregularity and the structural chaos which characterises many otherwise well regulated and eminently productive works. They seem, like the Topsy of immortal memory, never to have been born, or rather built, but simply to have "growed." There is some excuse for such a condition of affairs in establishments which are of somewhat venerable origin, and which, pitchforked at their inception into a sort of one-man-and-a-boy state of existence, without any thought of a future, have grown, or rather spread, under a sort of protest, and by dint of force of circumstances, rather than by any more normal process. There are many works we know, too, of more modern establishment, which to-day manufacture and trade under the most crushing difficulties because in their original disposition there was an absence of ability to consider the elements of proportion and industrial convenience in

the arrangement of the premises, leaving out of consideration all possibilities of extension to cope with increasing trade, or of modifications to meet the requirements of altering conditions of manufacture. The fact that such remarks do not now apply to the majority of successful modern engineering works of either large or small calibre in no wise diminishes the value of the suggestive paper contributed to this number of our Magazine by Mr. T. Scott King, M.I.M.E., to those who are presently, or likely in the future to be, engaged in the design and equipment of such establishments. The author of the article strings together in their proper sequence the results of much practical experience. Much that is there recapitulated will be familiar already to some readers, but taking the paper as a whole it will be regarded as a valuable addition to the literature of a subject which in the past received but scant attention. He reminds us that: "It has been the lot of many engineering firms in this country to design and build their Works in a manner which rendered extensions of premises unnecessarily expensive, and in some cases absolutely impossible." The study of Mr. Scott King's article is well calculated to prevent such crudities in the future. One other passage may well be quoted: "The most suitable time to build new Works," says our author, "and to make extensions to existing Works, is undoubtedly when the trade of the country is at the ebb, and consequently labour and material are cheap. The capital outlay will be reduced 10 to 20 per cent., and the loss and inconvenience due to removing plant and re-organizing in a busy time is avoided." This is undoubtedly true, but how few even amongst firms of large resources have pluck enough to seize the convenient moment? In these competitive days it is the flow that brings the trade which suggests extensions, and when it comes to the turn of the ebb, the supervening dulness hardly encourages avoidable outlay, even for capacity to compass a prospective flow. At the same time the validity of Mr. Scott King's contention remains beyond dispute.

Water Power . . .
Room for Enterprise.

PROBABLY one of the best and chiefest forms of available natural energy is to be found in the falling weight of water, and yet it is only just recently that we have harnessed a portion of the Niagara Falls. So far as we know, this tremendous force or energy of probably seven to eight million horse-power has been running to waste through all the centuries, and even now we are only utilising some five to six per cent. of the total power. To come nearer home, however, we have in Great Britain, and especially in the mountainous parts of the West of England, Wales, Scotland, and Ireland, a considerable quantity of water running to waste, but which might in its passage be made to give off some of its energy, and profitably so. Objection to this will be raised on the grounds that, as a rule, where the water power is there the towns are not, and that railway or transit facilities reduce the value of the cheap motive power. We have reason to believe, however, that the matter has really never been seriously gone into in this country, and that owing to the great improvement made in Turbines in recent years, there is room for considerable enterprise in this direction. Great numbers of water-wheels might advantageously be replaced by turbines, even when the fall is low. The difficulties (where such exist) in regard to the transit of goods manufactured are likely to disappear in the near future if the promise of electric and even more modern forms of traction is borne out, and it is therefore not improbable that some of our remote districts may before long become centres of great activity. At any rate, we think that much more ought to be done in this direction than has at present been attempted.

"Made in Germany" . . .

IT is possible, it seems, to make too little of this familiar expression, as well as too much, and the British manufacturing and trading public should be indebted to their Consul-General at

Frankfort-on-Main, Sir Charles Oppenheimer, for reminding them of this. In his last report to the Foreign Office, he is careful to point out that there is a vast difference between the crushing verdict of Professor Rouleaux, at Philadelphia, according to which "Germans" could only produce "cheaply and badly," to the admiration of its mercantile competitors, and the present position attained in the markets of the world by German manufacturers and merchants. "England," remarks the Consul-General, "may unreservedly admit Germany's success," although, he wisely adds, "One ought to be on one's guard against glorifying the same at the expense of British industry."

But the logical conclusion of it all, then, seems to be, that we can make too little of Germany's capacity as a competitor, as well as, occasionally, too much. "Made in Germany" has long since lost the *soupçon* of contempt which formerly attached to it. Time was, and not so long ago, when nothing was bad enough to be associated with German origin. The standard of German production has advanced to one within easily measurable distance of our own. In some particulars there is only the most trifling margin in our favour. And now Germany knows it, and finding that it tells in the market in its favour, it shows no inclination to return to the fustian and shoddy of a previous decade. What is the result? We shall let our Consul-General reply: "The machine factories were busy during the entire year [1898]. The locomotive factories have even orders for the year 1899, and new tenders are in view. The waggon factories are also fully occupied for months to come. The electro-chemical industry has undergone stormy evolutions, but has undoubtedly an upward tendency. The erection of central electrical stations, the conversion of many municipal tramway lines into electric roads, and the building of electric trolly-roads, offer further opportunities for future good employment. . . . The shipbuilding yards were fully occupied. . . ." And there is much more in this strain—enough to convince the dullest intelligence that, whilst it may be bad policy to din it into the ear of Germany that it is making vast industrial headway, we should keep the fact well under our own notice, and recollect that the familiar expression, "Made in Germany," is no longer regarded as a reproach in the markets of the world.

Possible Revolution in the Glass Bottle Industry . . .

THREATENED industries are very much like other things that are threatened: they are apt to last a long time. And so it is that the glass-bottle manufacturing trade, which at various times has been threatened with revolution at the hands of the engineer and inventor, still lives and flourishes in its old-time accepted fashion. Possibly this immunity from radical change has been largely attributable to the fact that those who have interested themselves in devising machines to supersede present hand-and-mouth methods—for the mouth has as much to do with present-day bottle-making as the hand—have singularly failed to grasp the essential feature of the time-honoured process of bottle production. It would almost seem as if the perfect bottle cannot be produced without the historic blowing-pipe, and the inventor of the new bottle-making machine, which is illustrated and described in another part of this issue, has hit upon the original, but very natural, expedient of imitating the action of the living bottle-blower in the use of his blowing pipes. The devices employed are ingeniously contrived and simple in operation, and the results obtainable are, we are assured, all that can be desired. The new bottle-making machine is, we understand, in successful operation in Bavaria, and if in continued industrial practice the new system gives as satisfactory results as it has done in tentative instances, there can be no question that it is within the range of possibility that existing methods of glass-bottle making may be entirely revolutionised. This would be of the utmost importance to this country, where bottle making has by no means reached the developments which have taken place in Germany, either quantitatively or otherwise. In any case, from an engineering point of view the invention is of

much interest, and, if present promise be fulfilled, much more is likely to be heard of it.

China Clay . . .

PROBABLY less is generally known about this substance, the process of its manufacture and its uses, than is known of many others of far less value. We shall have occasion to deal more fully with this subject in a subsequent issue, but it may perhaps be interesting to briefly record here the usual methods adopted in its preparation. A running stream or some other source of water is an essential feature, and fortunately water is fairly plentiful in those districts where china clay is found. The process is exceedingly simple, as water is allowed to run down the sides of the pit or mine, and in its passage picks up, so to speak, the clay in its transit. The mixture is then pumped up into suitable settling tanks; it is then run into what is termed a "dryer," and afterwards packed in wooden casks for transit. There is very considerable room for improvement in a system which is both antiquated and uneconomical, besides which there is a waste product which has not yet been dealt with, and which gives some trouble. This also is a field which calls for greater attention than it has at present received.

The Engineer in Britain and America . . .

AN article in this number, which will be read with much interest, alike by employers and employed, is that contributed to our pages by Mr. Tom Mann. It is curious to note how men, ordinarily so much opposed to each other on most industrial themes as Sir W. H. Preece, K.C.B., F.R.S., writing in our last issue, and Mr. Mann, writing in this number (leaving out of consideration other writers who touched upon the subject casually last month), should so closely and unconsciously, perhaps, coincide in their ideas upon points concerning the working man generally, and the working engineer in particular, upon which differences of opinion are so sharply defined. Mr. Mann takes, it will be seen, a broad view of the position of the worker in this country, gauging not unfairly or inaccurately his merits, as well as the limitations of his capacity as a mechanic. Compared with the American the British worker seems to be at some disadvantage, but, as Mr. Mann says, in reference to another phase of the subject, "it all hangs on environment." Mr. Mann's reference to the attitude adopted by the Amalgamated Society of Engineers towards the introduction of more efficient machinery is expressed in very cautious terms throughout, and he insists that the opposition has been as much on the employers' as on the men's side. We need not quote here the points which Mr. Mann makes both for and against the British engineer. Their significance will be best appreciated when they are read in their proper sequence in the article, which we commend as being worthy of careful perusal and consideration. We do not necessarily endorse all the opinions expressed therein, preferring to leave to our readers the task of drawing their own conclusions.

American Locomotives for British Railways.

CONCERNING the placing of orders for locomotives for English railways in America, we have received an interesting communication from Sir Lowthian Bell, in the course of which he says:

> "I believe that the only reason for the Midland Railway Company of this country ordering twenty-five engines from the United States arose from their inability to make them themselves or to obtain them at a sufficiently early date from other manufacturers, the reason of this being that every one had more orders than they could execute."

We can only deplore the fact that the resources of the works of our great railway companies and manufacturers combined are unequal to the exigencies of an ever-increasing prosperity. Eliminating the case of the manufacturers, it is conceivable, and moreover possible, that every well-conducted railway works of any magnitude should be self-sufficient as regards its supply of locomotives, and the exercise of a judicious foresight in the inevitable slack periods would probably have saved some of the locomotive superintendents having recourse to such an expedient as the one under consideration.

Notes.

A SPECIAL plate in this issue is devoted to an illustration of the new Colt automatic machine gun, which, we understand, is about to be manufactured in this country.

The Colt gun is a notable illustration of the fact that, in mechanics, development always lies in the direction of extreme simplicity. Compared with the complicated structures typical of the essays of early machine guns, the Colt is a marvel of mechanical evolution, its component parts representing what appears to be an irreducible minimum in their number, whilst so carefully proportioned and perfectly adapted to their duties, as to render the entire work a triumph of mechanical ingenuity and manufacturing skill.

The field of artificial lighting is rapidly and steadily extending. Several new factors are concerned in this, apart from the growing adoption of a higher standard for both private and public lighting. Of these, the introduction of a true electrolyte as an incandescent has aroused the greatest expectation; though, as yet, in the shape of the Nernst it has been responsible for more misgivings in the minds of British shareholders than for any appreciable effect on the lighting industries.

Another electrolyte incandescent is promised by Dr. Auer, and as we understand, this expectation is in part responsible for the present maintenance to its present standard of the stock of the Welsbach Company. In any case, it is to be remembered there is a possibility that both of these lights, so far as their patents are concerned, may eventually be held to have been anticipated by the invention of Jablochkoff.

Then, we have a two and a-half watt lamp promised on the market from a new manufactory in Westminster; while the recent sensational reduction in the price of electrical current in London foreshadows the time when electrical vacuum lamps will be competing with coal gas at 2*s*. 3*d*. per thousand. Then there remains acetylene; a curious and attractive illuminant that may attain a certain vogue, though its history so far has been chiefly illustrated by the constant recurrence of failures of pettifogging acetylene limited companies.

In the last issue of a contemporary we observe an illustrated article entitled "The Story of Smokeless Powder," which is noticeable not so much for any new facts, of which it is indeed practically destitute, as for the careful omission from the list of experimentalists given on the subject, of the name of Hiram Maxim. This omission appears particularly significant in face of the celebrated case of Maxim *v.* Anderson, one of the most important patent *causes célèbres* in the history of the Law Courts. In that action, which was fought to the House of Lords, and in which Maxim unsuccessfully sought to upset the Abel-Dewar patents, Maxim's claims as a pioneer in the manufacture of nitro-glycerine explosives for ballistic purposes were conceded and the validity of his own patents in connection with them tacitly admitted. It was contended only that the Abel-Dewar patents were not an infringement of them. This partial treatment of a scientific subject in any publication professing to be an authority is to be deprecated.

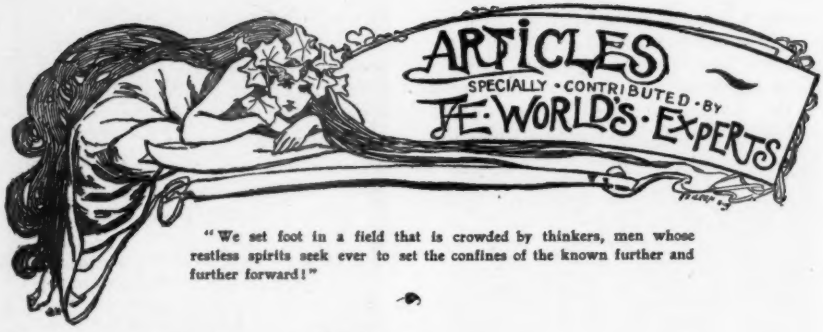
The disposition attributed to the executive of certain municipalities to adopt a hostile attitude towards motor cars and to embarrass the use of these conveyances by harassing prosecutions, is susceptible, according to information we have received, of two views. We fancy, that in more than one or two cases a prosecution for driving at an excessive speed has been deliberately planned; for, properly utilised, such a form of publicity may constitute an advertisement for the makers of the car involved that is decidedly cheap at the price. We do not refer to recent cases where an effectual defence has been put in, but to some others of older date where no attempt has been made to dispute the allegations, and the penalty paid with a cheerful and suspicious alacrity.

SUP

Photo by Elliott & Fry.

PROFESSOR SIR WILLIAM C. ROBERTS-AUSTEN, K.C.B., D.C.L., F.R.S.,

PRESIDENT OF THE IRON AND STEEL INSTITUTE.



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

On the nature of the Fracture of Armour Plates.

By Sir WILLIAM ROBERTS-AUSTEN, K.C.B., D.C.L., F.R.S.

❀ ❀ ❀

Professor Sir William Chandler Roberts-Austen, K.C.B., D.C.L., F.R.S., Chemist and Assayer to the Royal Mint from 1870; also Professor Royal School of Mines from 1880; born 1843; son of George and Maria Louisa Roberts; assumed the name of Austen at the request of his uncle, Major Austen, 1885; educated Royal School of Mines; appointed to the Mint in 1870; elected F.R.S., 1875; succeeded Dr. Percy as Professor of Metallurgy at Royal School of Mines, 1880; created C.B., 1890; has served on many Departmental and other Committees; Honorary General Secretary of the British Association for the Advancement of Science; received the Degree of D.C.L., Durham University, 1897; author of "An Introduction to the Study of Metallurgy"; is or has been Vice-President of Chemical Society, Physical Society, and Society of Arts; created K.C.B., 1899. He is President of the Iron and Steel Institute.

❀ ❀ ❀

When a projectile is fired against an armour plate the projectile may be shattered. On the other hand, it may remain more or less intact, while the plate is either penetrated to a greater or less degree, or, if it be brittle, fractured, with or without portions of it being actually detached. The behaviour of a plate under such treatment presents many points of interest which have hardly received the attention they deserve. A hard plate may, in fact, be viewed as if it were a colloidal mass, such as glass, while a soft plate behaves more or less as a viscous fluid would under the impact of the shot. It may be well to deal with the case of the fracture of the plate first.

The fracture of colloids is very peculiar and was partially investigated many years ago by the late Professor Frederick Guthrie, F.R.S.,* who selected glass as a basis for examination. He pointed out that a property of solid colloids is that they have neither crystalline form nor planes of cleavage, and when such a body is broken it presents what is called a conchoidal (or shell-like) fracture. An agglomeration of crystals may present, in mass, the conchoidal fracture usually characteristic of colloids. This is true of crystalline rocks and eminently so of basalt. He found that if a round plate of glass is placed in a thick soft cloth and pressed in the centre by a round cork, it cracks radially, the

* *Phil. Mag.*, Vol. viii., 1879, p. 25.

cracks being slightly curved, as is shown in Fig. 1. If, however, internal stress in a plate is produced by difference of temperature, the resulting fractures possess great regularity and beauty. The form of the fracture may still be essentially radial, but the fragments, even when the

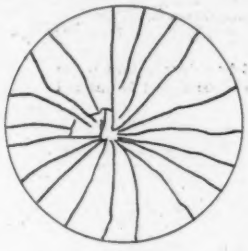


FIG. 1.

primitive radial type is widely departed from, present wonderful symmetry. A noticeable point in this mode of fracture being the invariable appearance of two pieces on opposite sides of the centre, the form of which is approximately rectangular, that is, their sides are half cords instead of radii. Such fractures are shown at *a*, *a*, Figs. 2, 3, and 4. Their form suggests that there are two chief centres of maximum fracture, and that the bounding

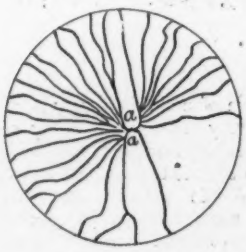


FIG. 2.

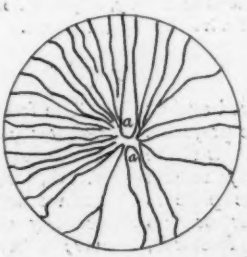


FIG. 3.

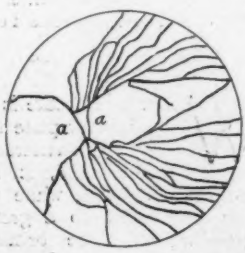


FIG. 4.

radii of the two systems are parallel. Dr. Guthrie then asks: "What is a crack? What are its beginning and its end? . . . . A crack is neither a line of least cohesion, nor a line of greatest strain. Nor is it a line where $\frac{c}{s}$ has a series of minimum values. The more perfectly elastic a medium is, the more fully does the crack resemble a flash of lightning or a wisely laid railway-line, and the more it departs from the river-course or the descent of a globule of mercury down an inclined but undulating surface. Its path is the curve whose course is determined by the integral of $\frac{c}{s}$ being a minimum. The sudden splitting through of the solid æther by the electric discharge furnishes us with figures by no means remotely resembling those of the fracture of glass."

It is interesting to compare the characteristic fractures of certain armour plates with the fractures of glass described by Dr. Guthrie. With this object in view, I applied to Lieut.-Col. C. F. Hadden, R.A., who most kindly allowed me to examine a large series of plates, and although it is quite unnecessary to give full details respecting them, I may appeal to certain results which will serve to illustrate this article.

The simpler case of radial fracture presented in Dr. Guthrie's Fig. 1 is of less frequent occurrence than might be imagined. A case is, however, presented by the fracture of a steel plate attacked by an ordinary armour-piercing shell (Photograph A).

On the other hand, the examples presented by Dr. Guthrie's Figs. 2 to 4 are frequently met with. Take the case, for instance, of a 9-inch compound armour plate, penetrated by one of Hadfield's chromium-steel projectiles, an account of which was published by himself.* The striking velocity of the projectile was 1,825 feet per second and the striking energy 2,250 tons. The face of the plate

* *Journ. Iron and Steel Inst.*, 1892, Part 2, p. 94, plate 6.

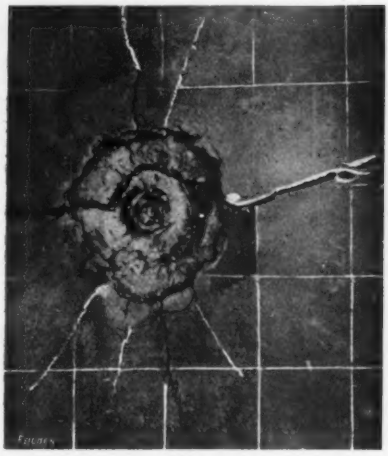


PHOTO. A.

contained 1.25 per cent. of carbon, an important point to remember in considering the nature of the surface of the plate, and, consequently, of the fracture. It will be seen that the portion marked *a* in the accompanying photograph (B) distinctly corresponds by its curvature to the rectangular portion characterised by Guthrie.

Another case is presented by a 6-inch cast steel armour-piercing projectile fired against a 6-inch Harveyed nickel-steel plate, with a striking velocity of 1,840 foot seconds. The curvature and rectilinear character of the portion marked *a* is here shown very clearly, though unfortunately the fracture is too near the edge of the plate to reveal the opposite and

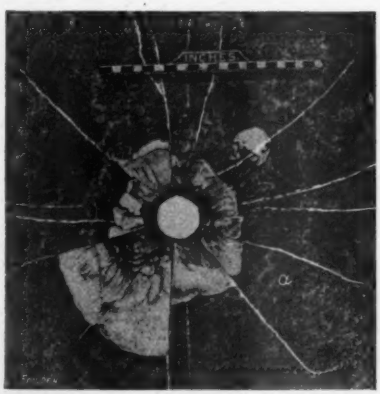


PHOTO. B.

PHOTO. C.

corresponding rectilinear piece to *a* (Photograph C).

It is well known that if a plate—say, a window—be cracked by a stone, a crack produced by a second missile will be arrested when it reaches a former crack. Such cases of arrested fracture are common in armour plates. There are curious cases in which a fine second crack will adopt a previous crack, run along it, and then break off. Dr. Guthrie proved

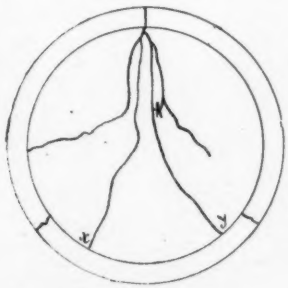


FIG. 5.

this by ruling concentric circles with a diamond on a plate of glass, as is shown in Fig. 5. It will be seen that the cracks *x*, *y*, on reaching the circular diamond cut, adopt it and cause a fracture right and left on the outer ring of glass. Such a case is

frequently presented where the projectile, in flaking out a large conchoidal fracture, has produced a series of circular concentric cracks, which appear very minute in the photograph (D). On careful examination

PHOTO. D.

of the plate (Photograph D) the conditions revealed by this diagram (Fig. 5) may be observed. In Fig. 6, *a b*, *c d* are concentric cracks, and *e f g* are secondary and subsequent cracks, starting from and adopting, as it were, the cracks *a b*, *c d* for a certain distance and then starting across them.

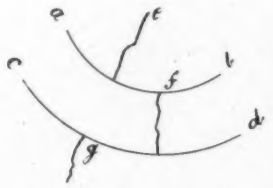


FIG. 6.

A crack, however, is really a more complicated thing than we have as yet considered it to be. It rarely happens that a sheet of glass or even metal, breaks by radial cracks in only two pieces when it is subjected to unequal stress. Two main cracks in a plate do not start radially, but the lines form a kind of inverted Y, thus:—

and join before reaching the circumference of the plate (Fig. 7) thus:—

FIG. 7.

Very often there is a central crack thus (Fig. 8):—

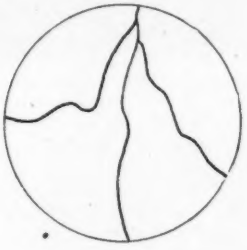


FIG. 8.

A crack starting radially from X may develop into a second crack thus:—

Beautiful examples of such cracks, as shown in photograph E, at *a*, *b*, *c*, were presented by an 8·9-inch Harveyed-steel plate attacked by a 9·2-inch armour-piercing shot with a striking velocity of 1889 foot seconds.

The question now arises, what will happen if the plate instead of behaving like a more or less brittle colloid, resembles a fluid one. In order to answer this, it is necessary to consider what the effect would be of the impact of a more or less spherical mass falling into a true liquid. As regards liquids, this has been beautifully worked out by Professor Worthington, F.R.S.,* who used milk, the white surface of which

* *Phil. Trans. Roy. Soc.*, Vol. clxxxix., 1897, p. 137, and *Proc. Roy. Soc.*, Vol. xxv., 1877, pp. 261, 498, and Vol. xxxiv., 1882, p. 217.

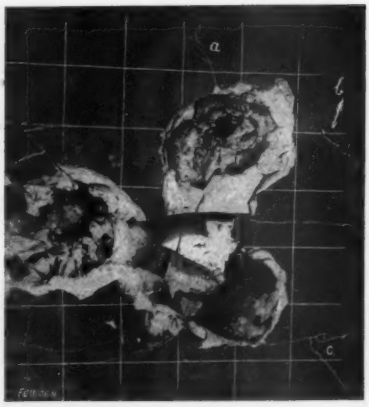


PHOTO. E.

allows a photograph to be taken easily. Some of these experiments have been repeated by the author of this article, and in Photograph F a marble has been caught just as it touched the surface of the milk. Instantly a splash was produced, and within a period of time not exceeding one-tenth of a second it was transformed from a coronet-shaped (Photograph G) to a columnar splash (Photograph H). The author of this article extended Professor Worthington's experiments to molten metals, especially to molten gold, a bullet of pure gold replacing the marble. The splash of the molten gold (Photograph I) is practically identical with that of the milk splash. But it may be argued that this is only to be expected, that the splash of the molten gold should be

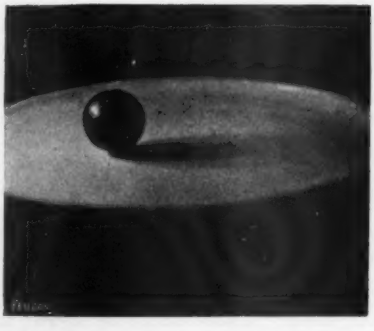


PHOTO. F.

almost a reproduction of the splash of the milk. There is, however, another and a further step, which is, the substitution of soft steel armour plate for the milk and molten

PHOTO. G.

gold and the introduction of the projectile in place of the marble and gold bullet. What will be the result when a solid pro-

PHOTO. H.

jectile of steel is urged against a solid soft steel armour plate with a velocity of some 1600 ft. a second? The results may vary

PHOTO. I.

within wide limits; the object of the maker of the projectile, that is, of the solid drop, is to penetrate the armour plate, while on the other hand the maker of the plate hopes to stop the projectile. If the former wins and the plate is wholly or partially penetrated, a splash will often be the result, and allowing for the difference between the flow of a solid and the flow of a liquid, the splash of the solid steel strangely resembles the splash of the fluid gold. Photograph J shows such a steel splash. In this case a steel projectile weighing 6 lb. with a charge of $7\frac{3}{4}$ oz. of cordite was fired with a muzzle velocity of 1756 ft. per second, against a soft armour

PHOTO. J.

plate of rolled mild steel 3·0 in. thick, and it produced in the $\frac{1}{3000}$th of a second this beautiful splash of the steel plate which seemed so solid.*

The complicated question of the fracture of armour plates has only been indicated in this article, and there still remain some other modes of fracture to be considered. It is well known that the impact of a projectile on the face of a hard armour plate is often to detach a

PHOTO. K.

conical mass from the back of the plate. This is well shown in Photograph K, which represents the back of a 6-in. nickel steel plate, the circular cracks forming the bases of more or less detached cones of metal. Suppose pressure is exerted at the point *a* (Fig. 9), the components of the force are shown in the diagram, and the tendency is to detach a conical mass *b a c*, but at the same time singular lines of force will

* Further particulars respecting illustrations F, G, H, I, and J, are to be found in a lecture by the author of this paper, entitled "Canada's Metals," and published by Messrs. Macmillan & Co.

be developed on the surface of the plate. Such lines of force are known as Lüders lines, and for an account of them the reader must refer to a recent article by Professor Alexandre Retjö,* of Budapest. Suppose the punch *a* (Fig. 10) be forced on to the supported plate of metal *b b'*, it will be found that lines like the engine turning of a watch will cover the surface

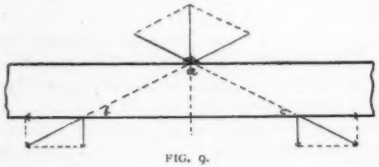


FIG. 9.

of the plate. In the same way if the punch be a pentagonal one and not a simple boss, the lines of force developed will be such as are shown in Photograph L. It remains to be seen, however, whether the existence of these lines of force can be detected on plates which have been attacked by projectiles. The complicated fractures which occur in a hard plate when the head of a heavy projectile breaks up on impact, are probably connected with these lines of force.

There can be no question that armour plates are of great importance to this country with its vast and maritime in-

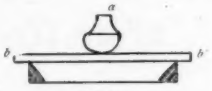


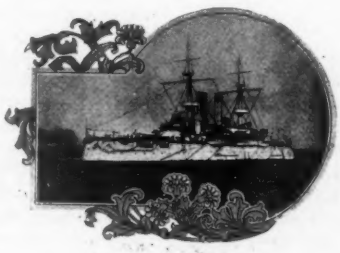
FIG. 10.

terests. The object of this paper has been to show that even the comparatively

PHOTO. L.

obscure problems which have been so slenderly treated here, must receive the attention they demand.

* *Baumaterialienkunde*, 4th year, No. 5 (Stuttgart).



The above article has been specially written for FEILDEN'S MAGAZINE by Prof. Sir W. C. Roberts-Austen, whose signature, however, we are unable to reproduce.

The Construction and Equipment of an Up-to-Date Engineering Works.

By T. SCOTT KING, M.I.M.E.

MR. T. SCOTT KING is a mechanical engineer of varied experience, which has been gained in purely representative works. Serving his apprenticeship with Messrs. Marshall, Sons, & Co., Ltd., of Gainsborough, he passed through shops in Nottingham and Woolwich districts, returning to Messrs. Marshalls' as assistant manager, a position soon exchanged for that of manager of the engineers' department. He later transferred his services to Messrs. Robey & Co., of Lincoln, as representative engineer in London, where he was engaged on special designs. He has given particular attention to the design, construction, equipment, and organisation of engineering works, and in this connection has carried out some important undertakings in the Midlands, and is now engaged in designing and planning large extensions to the works of Messrs. Davey, Paxman, & Co., Ltd., Colchester.

THIS subject necessarily receives increased attention from those mechanical engineers and manufacturers who recognise the economic capabilities of modern workshops equipped with plant of maximum productive capacity.

In many of the older engineering works very little effective thought has been given to the proper location of the different departments and plant to ensure the correct sequence of manufacturing operations, with the minimum transport of details. The lifting appliances have been slow, clumsy, and generally insufficient in power and number. In the past, cheap interdepartmental transmission of details has not received the consideration it deserves. In many works a serious annual loss is sustained owing to the excessive amount of unskilled labour required to handle the heavy castings, boilers, &c., which might be cheaply and expeditiously transported over light tramways, or by a suitable travelling gib crane.

The source of motive power has usually been a simple engine of automatic expansion or throttling type, using from 35 to 60 lb. of steam per brake horse power per hour, dependent upon its contiguity to, or remoteness from the boiler.

The charges for depreciation and fire insurance are also heavier in the old time brick and timber shops than in modern shops constructed of more durable and less inflammable material.

The foregoing losses acting conjointly with the known serious loss arising from the retention and employment of machine tools and plant of low productive efficiency, have prevented that reduction of cost in manufacture which is necessary to compete successfully in the markets of the world.

Many economies can be effected in existing engineering works by the intelligent re-organisation of machine tools and plant on sound manufacturing lines in weeding out inferior and obsolete plant, and replacing it with new plant of highest efficiency; by providing cheap and adequate lifting and transport facilities; re-modelling the system of power production and transmission; more perfectly organised control of details in process of manufacture, &c.

These economies obtain in a still greater degree in new works judiciously designed

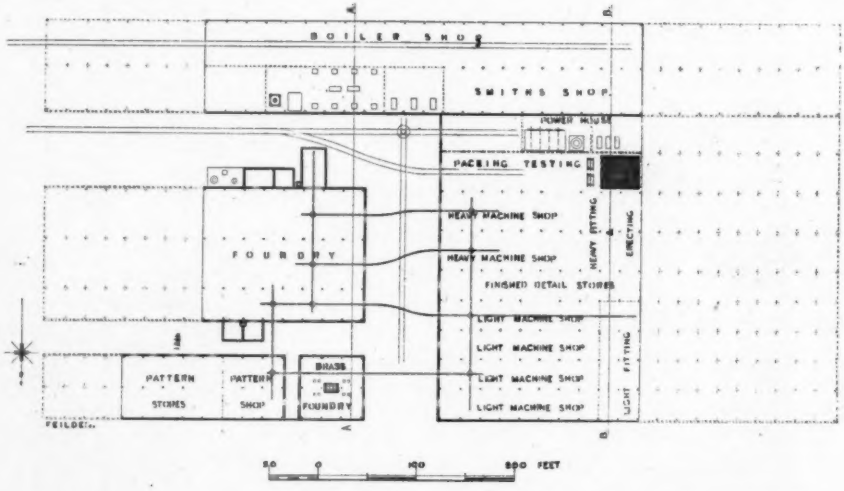


FIG. 1.—SHOWING PLAN OF WORKS WITH DEPARTMENTS PLACED TO REDUCE COST OF DETAIL TRANSMISSION, ETC.

condition that two or more railway companies' lines should have direct access to the works, and thus obtain the advantage of alternate routes at competitive rates for goods, inwards and outwards.

The site selected should preferably be at some small centre of population, on the outskirts of one of the great mining and metallurgical districts, so as to obtain prompt supplies of raw and manufactured material without heavy transport charges. The labour question will be less complicated in one of the smaller towns, and easier to handle than in a larger centre where similar industries exist, and workmen congregate in greater numbers. More healthful conditions usually prevail, and the cost of living is generally less in the smaller towns, and this influences the wage rate paid, which, combined with cheap land and low borough rates, all help to reduce the direct and indirect charges on the manufactured article.

to keep down the cost of production, and are supplemented by decreased fixed charges for depreciation, repairs, and fire insurance.

The most suitable time to build new works, and to make extensions to existing works, is undoubtedly when the trade of the country is at the ebb, and consequently labour and material are cheap. The capital outlay will be reduced 10 to 20 per cent., and the loss and inconvenience due to removing plant and re-organising in a busy time is avoided.

When selecting a site for an engineering works, it should be an indispensable

Fig. 1 shows a plan of works in which the departments are relatively placed to reduce the cost of detail transmission, and to provide sufficient space for the extension of any or all the shops to meet the exigency of a growing business. It is of

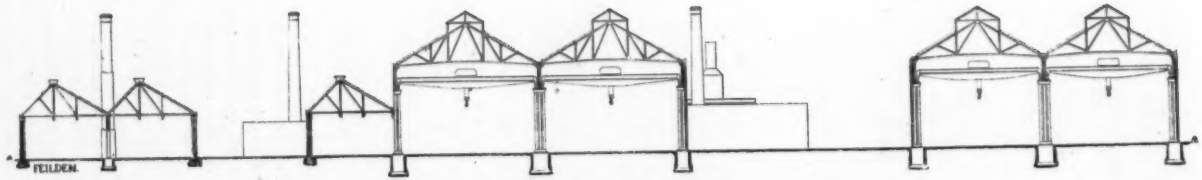


FIG. 2.—SECTIONAL ELEVATION OF WORKS ON LINE A A OF FIG. 1

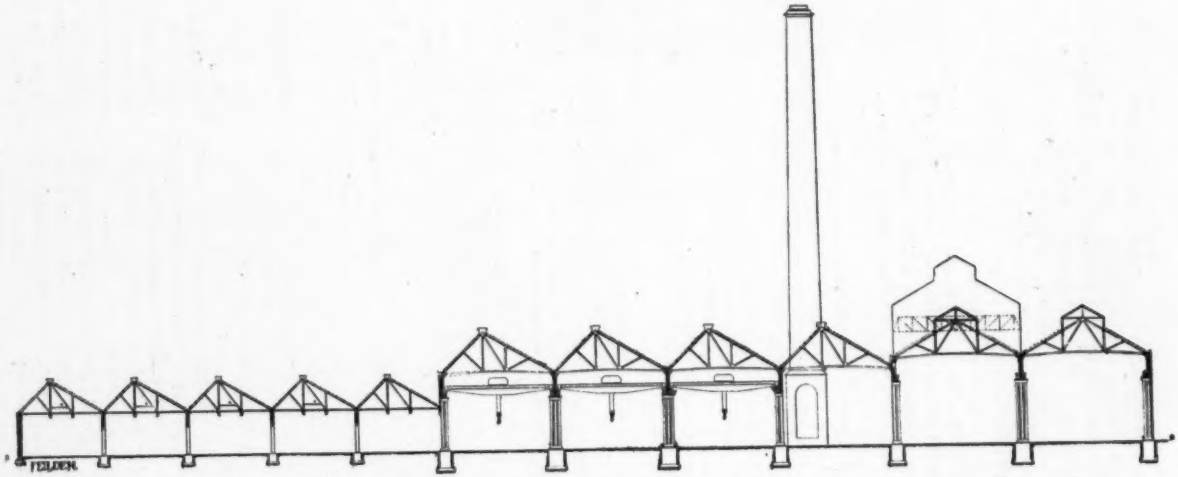


FIG. 3.—SECTIONAL ELEVATION ON LINE B B OF FIG. 1.

FIG. 4.—SHOP IN WHICH THE AREA OF GLAZING IS 40 PER CENT. OF FLOOR SPACE.

the utmost importance to arrange the departments and plant in such relationship and sequence that each subsequent operation of detail manufacture is performed with minimum intermediate transport, for it is impossible to achieve the maximum economy of production when details meander in all directions, and require a great amount of unskilled labour to move them backwards and forwards. Such conditions of working bewilder the minds of foremen and work men alike, by their lack of systematic and logical procedure.

Referring to Fig. 1. The railway connection is shown entering in the west of the site, and delivers direct to the foundry storage yard beside the cupolas, to the plate bay of boiler shop and to the iron store of the smiths' shop, where it also supplies coal to the central power station.

The cast details are delivered from the foundries direct to the machine shop, or if not wanted there can be placed in the intermediate storage yard, which is commanded by a travelling crane, steam driven with jib fitted with raising and lowering gear. This crane is also available for shunting and the general work of the yards.

The pattern shop and stores are placed on the north side of the iron foundry, and west of the brass foundry.

The machines in the engineers' department are placed at the west end and the detail in process of manufacture is moved forward to the fitters, who on completion send it into the finished detail stores or to the erectors. The heavy fitters and erectors fit up cylinders, beds, cranks, &c., complete and ready for assembling, which, in the case of heavy engines, is done in the steaming beds. Smaller engines are erected complete, and afterwards passed to the test shop to be steamed. The engines after testing are

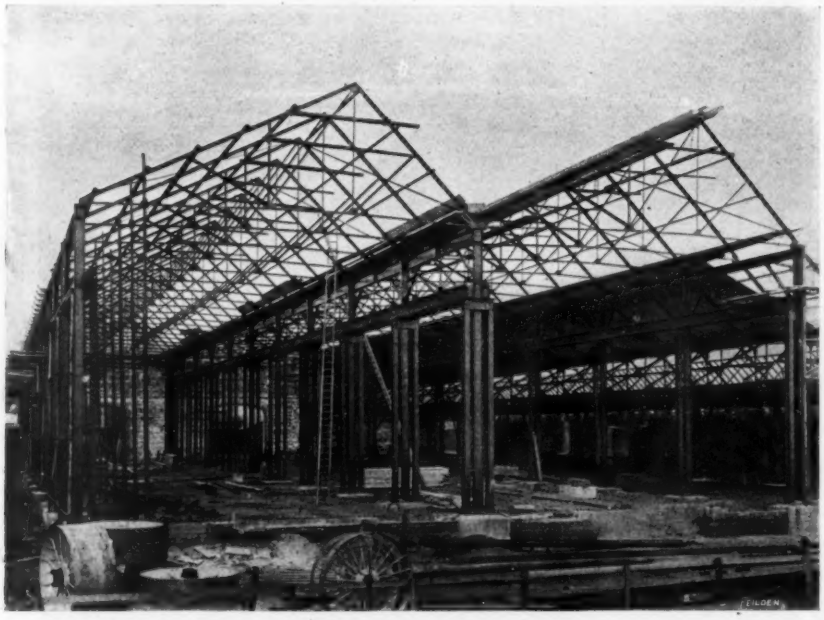


FIG. 5.—MACHINE TOOL SHOP.

then moved westward for cleaning, painting, packing, and despatch.

The general arrangement of the boiler and smiths' shops is self explanatory.

The productive capacity of the machine shop is essentially the measure of the output of a works, and the area of the other departments must be based upon its requirements. This proportion must be correct, not only when works are first built, but also when the original shops have been extended to the limits of the site.

It has been the lot of many engineering firms in this country to design and build their works in a manner which rendered extensions of premises unnecessarily expensive, and in some cases absolutely impossible. A large and increasing trade connection is the natural ambition of every manufacturing firm, but too often enterprises have been heavily handicapped in their later development by costly extensions of existing premises or the removal of the business to a more commodious site, owing to the lack of initial recognition of the ultimate requirements of an extending trade.

It is very advisable for engineering firms to acquire land in excess of their immediate necessities, so as to provide room for extensions, and also to design the works as they will appear when extended to their full limits.

Fig. 1 illustrates this feature of works

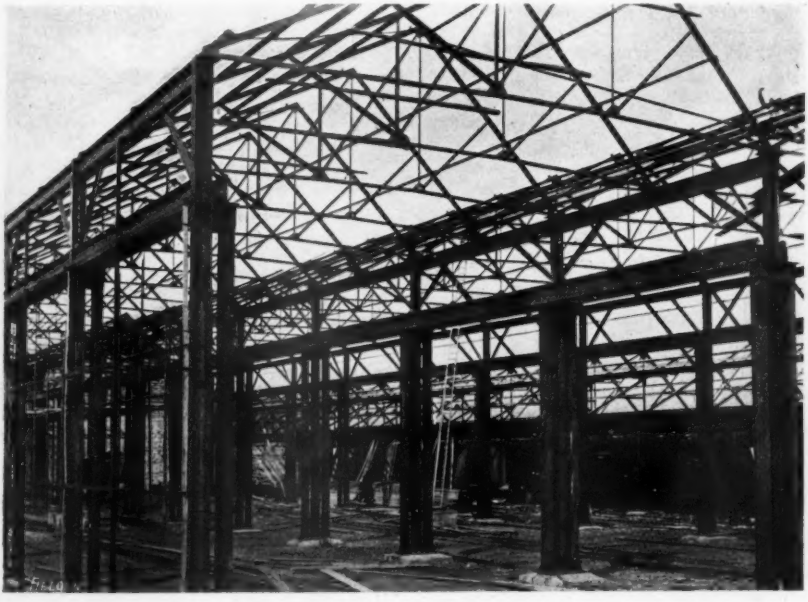


FIG. 6. MACHINE TOOL SHOP.

design. The shops shown in full lines represent works of moderate capacity, and the dotted lines indicate the natural growth of the works with the least capital outlay, and maintain the correct balance of departmental area and relative position. The portions first built contain the fixed plant, and form the nucleus around which the extensions are made. The growth of the works will not necessitate a general removal or revision of the plant, but the additions made will merely require the plate stores in the boiler shop, and the

fitters and erectors in the engineer's shop moving forward in the direction in which the building extensions are made, to provide the necessary spaces for additional plant. The walls and gables which are to form part of the permanent structure should be built of brick, but the temporary sides and ends should be covered with corrugated sheets on light steel framing. The roof boards and purlins should be finished up to the centre of the last roof principals in the direction of future shop extensions, and the intermediate space up to the gable sheeting should be made good with short lengths of boards and purlins. When it is necessary to extend any department endways, the additional portion can be erected, walled and roofed complete, ready for occupation without in any way disturbing the existing shop beyond taking out the short lengths of roof boards and purlins up to the centre of the last principal, so as to enable the new roof to be made good up to the older portion. The gable sheeting and steel framing is then taken down piecemeal, the concrete footings of the gable uprights are removed to form the foundation of the gables in their new position at the extremity of the extension. Should an extension be required on the side of an existing shop, the procedure is essentially the same; the additional bays are completed ready for use before the sheeting and framing are transferred to form the new outer wall. Under this system of extension work can be carried on as usual in the existing shops, and the men and plant are not exposed to the inclemencies of the weather. The sheeting rails should be clipped to the uprights, so that when they are removed no unsightly holes remain, and the upright is not weakened by cutting away material in the most effective part of the section. It is obvious that extensions carefully provided for and carried out on these or similar lines are necessarily less costly than if the system of extension had not received special consideration in the primary design and in detail construction.

Figs. 2 and 3 are sectional elevations of the works previously shown in plan on lines A A and B B.

The saw tooth or weaving shed type of roof has been extensively used in engineering works, with the steeper angle facing the north. The reflected light from the north is non-vibrant and most suitable for the finer operations of mechanical work executed on machine tools and by fitters. The shimmer of direct rays of the sun on bright metallic surfaces makes it impossible to attain that exactitude required in work of the highest class which is possible with clear steady light from the north. In addition to this advantage the shops are cooler in the summer time, and men can work in greater comfort.

The weaving shed type of truss costs a little more per unit of area covered than the equal span roof. The unequal angle moves the apex out of the centre of the span, and the load carried on the long rafter is greater than that due to the load on half an ordinary truss. The scantlings of this form of roof are approximately equal to that of an equal span roof in which the rafter is equal in length to the long rafter of an unequal-angled roof. The gables are also rather unsightly owing to their unsymmetrical appearance, and are somewhat higher than those of an ordinary roof.

It is very doubtful if any advantages accrue from the use of an unequal-sided roof truss in foundries, smithies, boiler shops, &c., for in these departments less refined processes are carried on, and the rising fumes from the fires, furnaces, stoves, &c., quickly render the glass partly opaque and temper the fierceness of the sun's rays. Good light in great abundance is essential to the production of high-class work.

Fig. 4 shows a shop designed and built by the writer, in which the area of glazing was 40 per cent. of the floor space covered, and the light was all that could be desired for a machine shop: clear, pellucid, and ample for the finest possible work.

Figs. 5, 6, and 7 illustrate new machine tool shops, and Fig. 9 boiler shop extensions now in course of erection by Messrs. Davey, Paxman & Co., Limited, of Colchester. The new machine tool shops are built entirely of steel, and consist of

two bays, each 35 ft. wide, suitable for heavy machine tools, and two bays, each 27 ft. wide, for light machine tools. The 35-ft. bays are 26 ft. 6 in. from the underside of the roof ties to the floor level, and the light bays are 13 ft. 6 in. high in the clear. The shop is bounded on the north side and west end by brick walls, for it is improbable that extensions will ever be made in these directions. The south wall and east gables are made and glazed. The longer slopes are boarded with $1\frac{1}{4}$-in. grooved, tongued and bevelled boards, placed diagonally, on which $2\frac{1}{4}$ in. by $\frac{3}{4}$ in. slating battens are nailed to carry the slates. Figs. 5 and 6 make clear the general construction of the 35-ft. bays. The columns are placed at 20 ft. centres, and the roof trusses are spaced 10 ft. apart. Diagonal strutting is resorted to in the light and heavy bays, not only to stiffen the roof-girders but also to

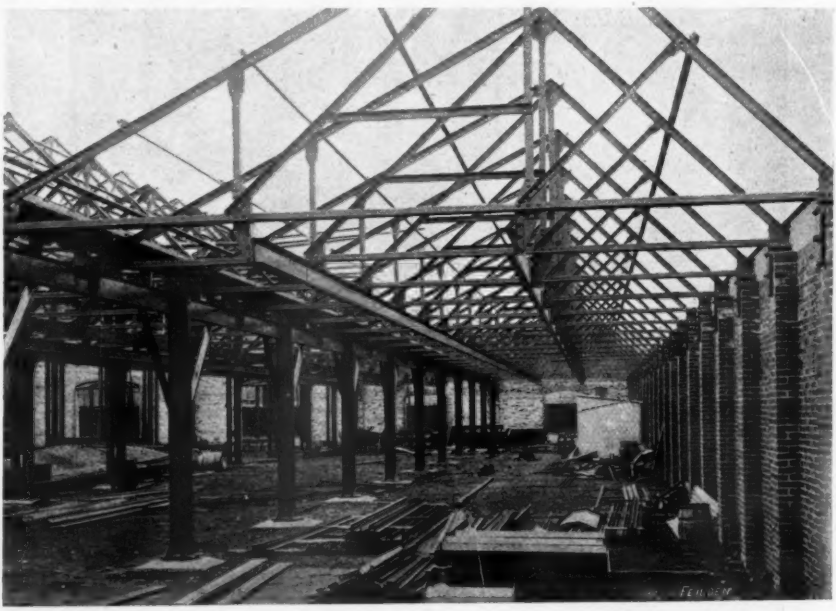


FIG. 7.—MACHINE TOOL SHOP.

of galvanised corrugated iron fixed to steel framing, which is arranged to permit cheap and expeditious extensions to be made. The present length of the shop is 200 ft., but it can be extended to the west to meet trade requirements another 400 ft. if necessary, and another 35-ft. bay can be added on the south side.

The 35-ft. bays are equipped with 10-ton rope-driven travelling cranes. The shop is lighted from the north, the weaving shed type of roof is employed, with the shorter angle placed towards the north, eliminate longitudinal racking. The roof principals, shown in Fig. 7, for the light bays are made of heavier scantlings than usuál to provide sufficient strength to carry one-ton cranes running in the channels under the roof ties as well as the main line shafts, counter shaft pulleys, brackets, &c., forming the overhead gear of the machine tools. The pedestals for the line shaft are bolted to two 3 in. × 3 in. × $\frac{1}{2}$ in. angles rivetted to the oblique and vertical roof ties.

The one-ton traversers each consist of

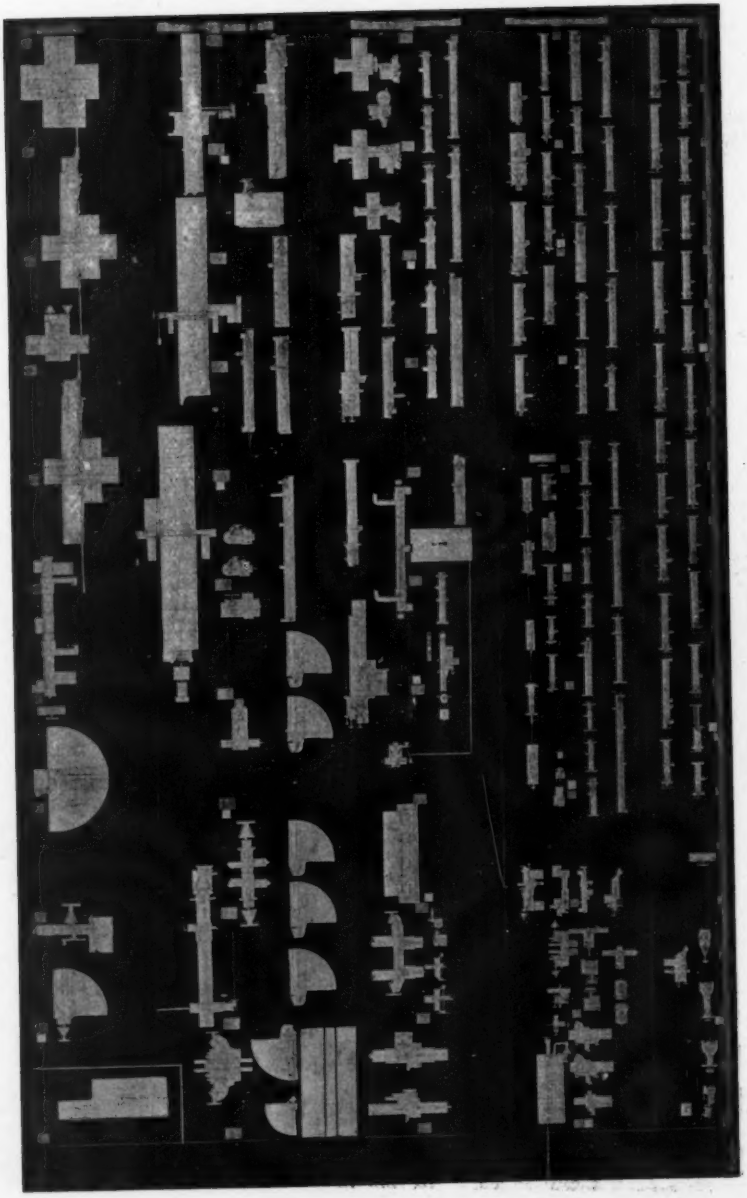


FIG. 8.—SETTING OUT BOARD FOR MACHINE SHOP PLANT.

one 8 in. by 4 in. joist, 20 ft. long, placed athwart the shop and attached to the underside of a small carriage, which runs between the longitudinal channels shown under the roof ties. The lifting blocks hang from a runner with wheels running on the inside of the lower flange of 8 in. × 4 in. joist.

The illustration, Fig. 8, is reduced from a photograph of the setting out board for the machine shop plant. The machine shop is marked down at a scale of $\frac{1}{2}$ in. to the foot, and paper models of the various machines and plant, to the same scale, are placed relatively correct to obtain the best possible disposition of the machines to facilitate detail production. This system of setting out to scale every machine in its proper position enables the arrangement of the plant to be fully considered during the construction of the shops, and when the tools are ready to fix provides a clear programme to work to. The line shafts in the heavy bays are shewn passing through the columns, and the couplings are indicated. The main driving engine is shown at the south-east corner of the shop, and for the present is belted across to the main line shafts. The main drive is arranged so that any line shaft can be driven or stopped by sliding clutches, which are operated from the floor.

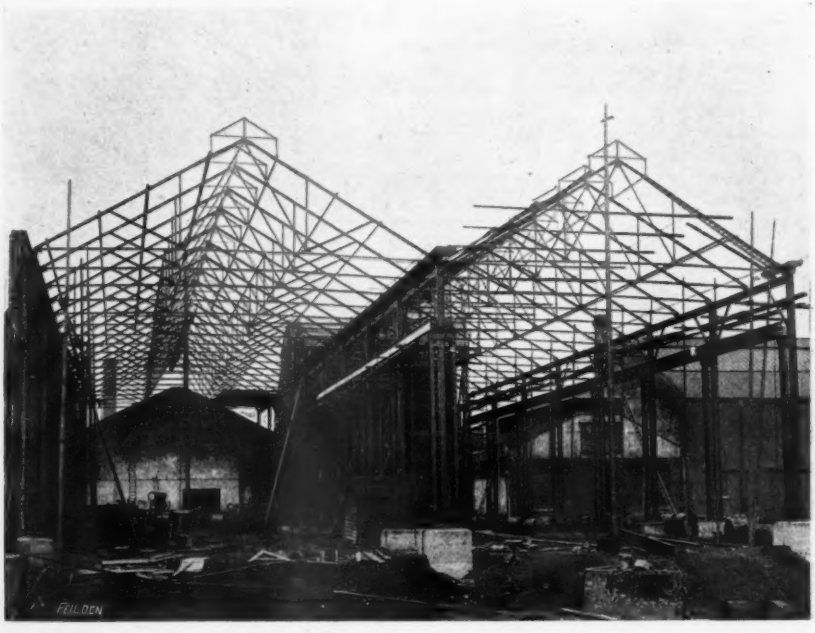


FIG. 9.—BOILER SHOP.

The boiler shop extension shown in Fig. 9 has two bays, each 45 ft. wide. The shop is built entirely of steel, and is 160 ft. long. The columns are placed at 20 ft. centres, and the roof trusses are 10 ft. apart. The right-hand bay is supplied with one 10-ton travelling crane, and the left-hand bay with a 25-ton rope-driven traveller. The roof ties are 29 ft. 6 in. above the floor level, and the cranes have a clear lift of 22 ft. 6 ins., so that the

largest boilers can be carried over other large boilers in course of manufacture. The light is admitted on both sides of the truss, and has an area of a little over 70 per cent. of the floor space covered. The louvre and the upper part of the roof is boarded and slated. The roof boards and purlin backings are the only portions of these shops which are of timber, and the fire risk is consequently so small as to render insurance a needless extravagance.

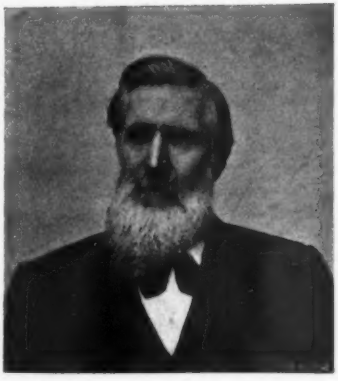
Many important points connected with shop construction and equipment must necessarily be omitted in an article of this length, owing to lack of space, and these notes must be accepted as a brief résumé of general principles, and not in any sense as a detailed exposition of the finer considerations affecting the selection of particular methods and designs to meet the ever-varying conditions of manufacturing requirements.

J. Scott Keltie

Piston and Ram Pumps:

Their Advantages and Disadvantages Practically Considered.

By PHILIP R. BJÖRLING.



MR. PHILIP R. BJÖRLING is recognised as a technical authority in this country on Pumping and Hydraulic Machinery, and is the author of numerous handbooks on the subject. Mr. Björling received his general and technical education in Stockholm, but has derived practically the whole of his experience from this country. He has passed successively through the establishments of Messrs. John Fowler & Co., Messrs. Garret, Marshall & Co., and their successors, Messrs. Hathorn, Davey & Co. Mr. Björling is now practising as a Consulting Engineer in London.

THE writer has been asked to contribute an article on piston and ram pumps. This is a very difficult task, because so much has already been written in periodicals upon this subject; but these articles have been written either by manufacturers themselves, or by some who are dependent on manufacturers, or editors of papers who have puffed up single firms to gain their advertisement and support. It is as great a folly to imagine that one class of pump is applicable for all purposes, as it is to design a pump-valve that will be suitable for all classes of liquids, fluids or semi-fluids.

It is the writer's aim in this article to give a brief history of the development of the piston and ram pumps, describe the peculiar features of each design, and lastly, to show to whom the credit of invention of each class is due.

If we desire to commence this subject from its origin, we must go as far back as the time of "Hero," an engineer and inventor of the Alexandrian school, the capital where most of the sciences were born. This gentleman mentions the pump of Ctesibius in his work on "Pneumatics." This work contains treatises of many useful and amusing inventions, amongst others the penny-in-the-slot, and nearly last on the list, the pump.

The pump mentioned by "Hero" is illustrated in Fig. 1, which is copied from the English translation of "Hero's Pneumatics," by Mr. Bennet Woodcroft. From this illustration it will be gathered that the pump was of the ram type, having two single-acting barrels, the rams being actuated by a beam, and the pump-valves of ordinary spindle type. Two of these pumps can be seen in the Bronze Room of the British Museum.

While excavating for the north foundation of the present London Bridge, several curious things were brought to light, amongst these were two cylinders or pump barrels, formerly belonging to some waterworks erected upon the spot; they were of cast-iron, with a bore of $6\frac{3}{4}$ inches diameter, each furnished with trunnions, similar to a cannon, for the purpose of securing them in their places.

These forcing pumps appear to have been immersed in the water whence the supply was taken, the suction or feed pipes being only 4 inches in length. The feed pipe of one, and the delivery pipe of the other, were of brass, very neatly united to the iron by brazing. The valves were

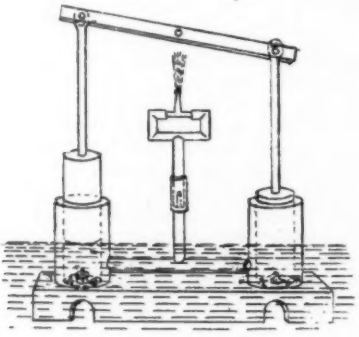


FIG. 1.—PUMP MENTIONED BY HERO.

not within the cylinders, but in *separate chambers*.

That these water-works were buried in the ruins of the Great Fire of 1666 there seems very little doubt from the appearance of one of the oak piston-rods, of such size as to nearly fill the cylinder, being burned in a conical shape, and in a better state of preservation than the other part. This piston was at the bottom of the stroke, the other being at the top, the piston-rod

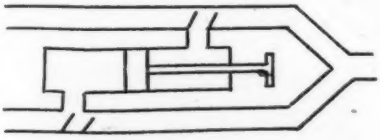


FIG. 2.—EARLY TYPE OF DOUBLE-ACTING PISTON PUMP.

whereof was missing, having been no doubt burned away, both pistons remaining in their respective positions. If our supposition is correct, these pumps must have been erected by Peter Morris in the year 1582, and were of the single-acting piston type.

This is the first instance the writer has found in which the valves were placed in *separate chambers*, all previous pumps having the suction-valve and pipe in a direct line with the piston or ram, and the delivery-valve chamber fixed at the side of the working-barrel.

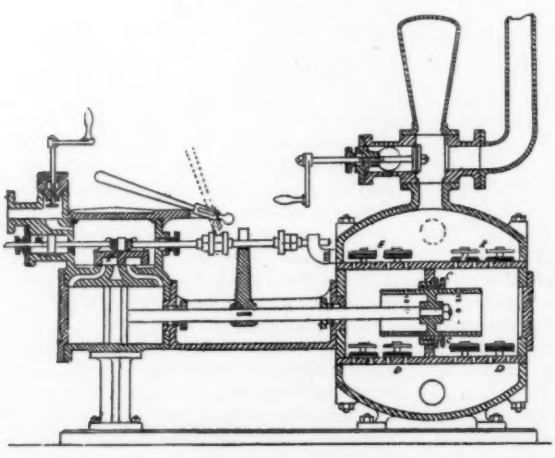


FIG. 3.

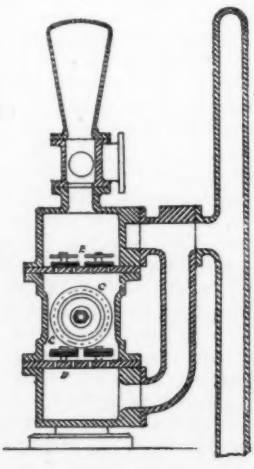


FIG. 4.

WORTHINGTON'S HORIZONTAL DOUBLE-ACTING RAM OR PLUNGER PUMP.

From that time up to the year 1674, we can find very little relating to pumps of any description, but in that year Sir Samuel Morland secured a patent. The most important feature in this pump was the gland and stuffing-box, which latter by many writers has been attributed to James Watt, although he only adapted it to the steam engine.

In the "English Encyclopædia," published in the year 1802, I find the following remarks:—"The forcing pump is sometimes of a very different form from that already described (the piston pump). Instead of the piston, which applies itself to the inside of the barrel, and slides up and down in it, there is a long cylinder nicely turned and polished on the outside, and of a diameter less than the inside of the barrel. The cylinder (called a ram) slides through a collar of leather on the top of the working-barrel."

It appears to me very singular that the

ADMIRABLE INVENTION OF SEPARATE VALVE CHAMBERS

should have been lost sight of from 1582 to 1702, then to have been brought forward as a new invention. This was done by Mr. Charles Simpson, who procured a patent for it in January that year.

So far, all the pumps I have described, both piston and ram, have been single-acting, but on perusing a work by Mr. G. Gregory, D.D., "Dictionary of Arts and Sciences," 2nd ed. (no date of publication given), I find an illustration and description of the double-acting piston pump, shown in Fig. 2; he states that it was invented by Mr. John Morton, the 13th of August, 1807. It consisted of a working barrel, closed at both ends, the piston-rod passing through a collar of leather at the top. This barrel communicated

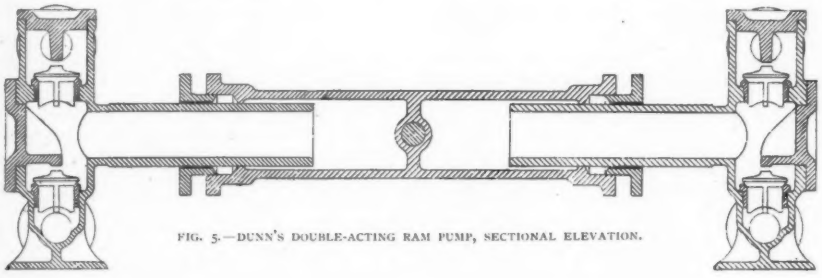


FIG. 5.—DUNN'S DOUBLE-ACTING RAM PUMP, SECTIONAL ELEVATION.

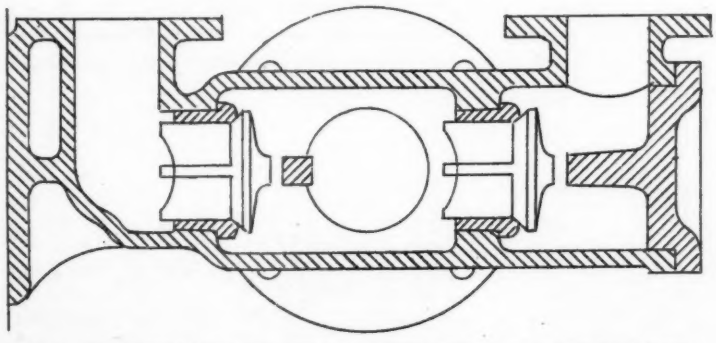


FIG. 6.—DUNN'S DOUBLE-ACTING RAM PUMP, CROSS SECTION THROUGH ONE OF THE VALVE BOXES.

laterally with two pipes, the communication being as near to the top and bottom as possible. At each of the communications are two valves opening upwards. The two top pipes unite into one large main, which bends a little back to give room for the piston-rod; the two pipes at the bottom may also be united into one large suction-pipe. Some writers state that the double-acting pump was invented by La Hire in the year 1718, but unfortunately they do not say if it was a piston or ram pump that he converted into double-acting.

Up to the year 1850 the usual practice was to make the double-acting pump of the piston type for horizontal pumping appliances; but in that year Mr. Henry R. Worthington of New York brought out his horizontal double-acting ram or plunger pump. This pump is shown in Figs. 3 and 4; B is the pump ram or plunger. It is double-acting and works through a metallic packing C; D, D, are the suction valves, and E, E, the delivery valves. This is the type of pump mostly used by Messrs. Worthington up to the present date.

Next comes the question, who is

THE LEGITIMATE INVENTOR OF THE EXTERNALLY-PACKED DOUBLE-ACTING RAM PUMPS?

Although we have searched all the patent records, and all the ancient literature, we have been unable to find one more ancient than 1859. In that year the late Mr. Thomas Dunn, of Manchester, secured a patent for a peculiar double-acting ram pump, one of which he exhibited at the London Exhibition, 1862. This pump has outside packed stuffing-boxes. The peculiar feature in the construction was that, instead of the ram moving backwards and forwards in the barrel or barrels, as the case may be, at every stroke, the pump barrel was made to slide on two rams, the latter being stationary. This pump is illustrated in sectional elevation Fig. 5, and cross-section through one of the valve boxes, Fig. 6.

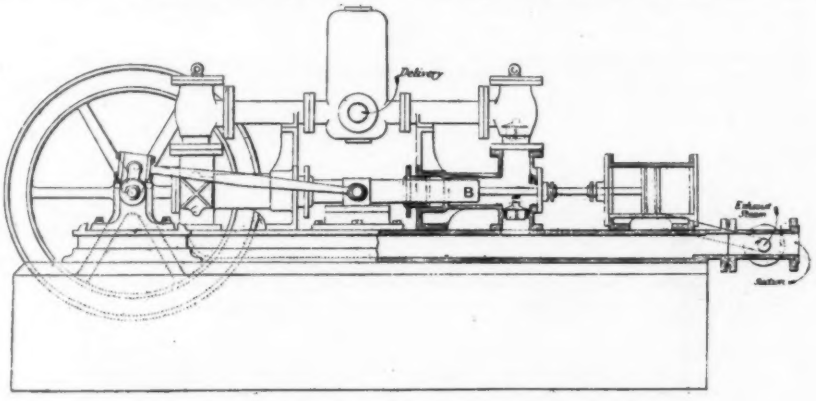


FIG. 7.—MESSRS. OMMANEY AND TATHAM'S DOUBLE-ACTING RAM PUMP.

Probably the ordinary horizontal double-acting ram pump was made long before 1859, for the writer has seen a circular of a pump made by the late firm Ommaney & Tatham, printed in 1860, and Mr. Frank Pearn declares that this firm made them many years previous to that date. Fig. 7 is a reproduction of the illustration shown in the circular, from which it will be noticed that the pump is of the externally packed ram type, driven by a steam cylinder direct, the piston-rod being coupled to the ram in the pump; the crank-shaft, which actuates the steam slide valve, is rotated by connecting-rods

coupled to a cross-head pin secured in the centre of the ram.

In the year 1870 we find a patent secured by Messrs. Richard Potter Pearn and Frank Kelsey Pearn, both of Manchester. This is illustrated in sectional elevation, Fig. 8; in this pump the ram B works through a stuffing-box, which is placed in the upper part of the lower working-barrel D; the upper working-barrel forms the gland; the two cylinders fit together, and are bolted up to one another. The pipe R passes through a stuffing-box in the bottom of the column J. This did not work quite satisfactorily, on account of air lodged in the pipe R.

Messrs. Pearn's next patent was exactly similar, with the exception that the pipe R was turned upwards, passing through a stuffing-box, T, in the upper part of the column J; this arrangement did away with the air lodge, the objection to the previous example. This latter pump is illustrated in Fig. 9.

Another modification of this pump is illustrated in sectional elevation, Fig. 10; and transverse section through one of the columns, Fig. 11. The principal difference being that the top part of the barrel S is fixed, consequently the gland and stuffing-box are dispensed with, and the two barrels D and S are packed by one gland and stuffing-box C. The advantage of the latter arrangement is so clear that it is hardly necessary to comment upon it.

In the year 1873 Messrs. Ezra Cope and James Riley Maxwell, of Hamilton, Ohio, U.S.A., patented in England the double-acting ram pump, illustrated in Fig. 12. A and A are the working-barrels; B a distance-piece by means of which the two barrels are held firmly together. The ram works in these two barrels, and is packed in the middle by two stuffing-boxes and glands. This is the type of double-acting externally-packed ram pumps, which, in slightly modified form, is mostly adopted by the English pump makers. Fig. 13 is a reproduction of a photograph taken of one of the earliest pumps of this type, made by Messrs. Hayward Tyler & Co., of London and Luton.

In the same year (1873) the same gentlemen patented an inside packed double-acting ram pump, illustrated in sectional elevation, Fig. 14; and end view, with the bonnet removed, Fig. 15. This pump is used for moderate lifts, and consists of a single working-barrel, A, pro-

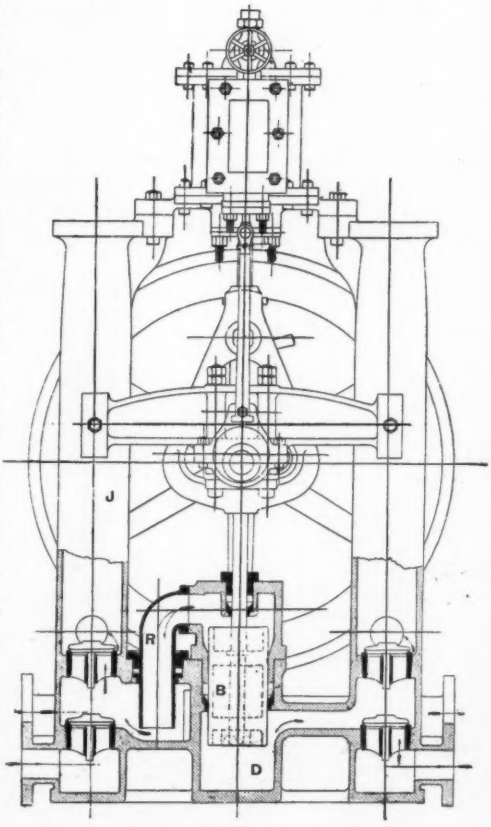


FIG. 8.—MESSRS. PEARN'S PATENT DOUBLE AND QUADRUPLE-ACTING PUMP SECTIONAL ELEVATION.

vided at or near its centre with a stuffing box, B, and gland for the ram, C, to work through; and each end of the barrel of the pump is connected with a set of inlet and outlet valve-boxes. D is a cover or bonnet, which covers the back part of the

pump, and in which the ram works. E are three screws, fitted with check or back nuts, for tightening the internal gland.

THE BEST EXTERNALLY-PACKED RAM PUMP

for heavy pressures, is undoubtedly the one illustrated in part sectional elevation, Fig. 16; plan, Fig. 17; and cross section through one set of valves, Fig. 18. This pump was originally manufactured at

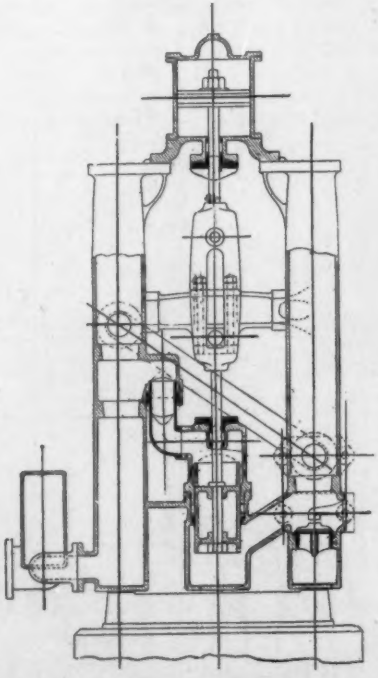


FIG. 9.—MESSRS. PEARN'S PATENT PUMP, WITHOUT THE AIR LODGE.

The Knowles Steam Pump Works, Warren, Mass., U.S.A., in the year 1867, the writer having in his possession a blue print of the original tracing with the date on it. It is of a peculiar construction, inasmuch that it has two separate rams, A and B, operating in two working-barrels; each of the rams being provided with a cross-head, C and D, and the two cross-heads are coupled together by means of two rods, E and E. The two working-barrels are, in this case, cast in one, having a diaphragm plate, L, in the middle of its length, so as to form two working-barrels, into which the rams work. One of the cross-heads is coupled to the pump-rod. The rams work through glands and stuffing-boxes, G and H, which are clearly shown in Fig. 16. J is the inlet branch, K the suction valve-boxes, L the delivery valve-boxes, and M the delivery branch. The top rod, E, works on guides, bushed with white metal, one on each end of the pump body.

Figs. 19, 20, and 21 are reproductions of pumping engines of the duplex type manufactured by Messrs. Frank Pearn & Co., of Manchester, fitted with this class of pump. Fig. 19 is a high pressure pump; Fig. 20 a compound pumping engine; and Fig. 21 a triple-expansion pumping engine.

The last pump we will draw the reader's attention to is Messrs. Frank Pearn & Co.'s 1893 patent vertical externally-packed ram pump. This pump is illustrated in Fig. 22, which shows the pump chamber in section. The ram A is of the ordinary type used in externally-packed double-acting pumps, but made much shorter, as it works through one stuffing-box only instead of two, as in ordinary double-acting ram pumps. B is the pump gland, which is the novel feature in this packing, as it not only performs the ordinary function of a gland, but is in addition the pump chamber, F, for one side of the pump. The collar for taking the gland bolts is screwed on after the gland is inserted through the top chamber, F. C is the ordinary stuffing-box, in which may be used spun-yarn or any other packing. D is a jointing to make a joint round the gland chamber B, and is slackened when the gland is required to be moved. The great advantages of this packing are, that a straight external packing is obtained in much less length than where two glands and stuffing-boxes are used. All leakage is external, and shows at once when requiring re-packing. Leakage from pump chambers, E to F, is impossible. There is only one stuffing-box; this reduces friction, and is less

MESSRS. PEARN'S PATENT PUMP (MODIFIED).

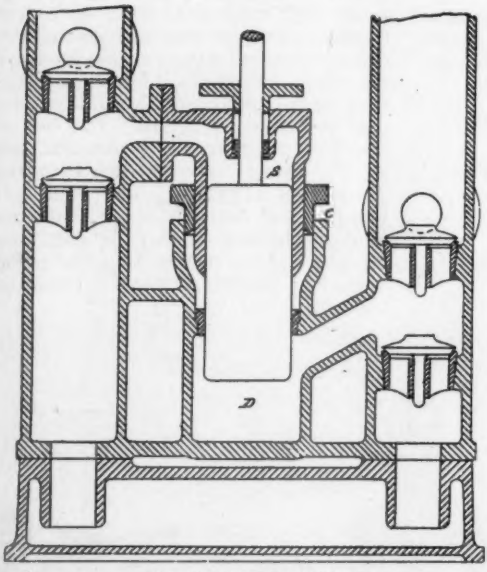


FIG. 10.—SECTIONAL ELEVATION.

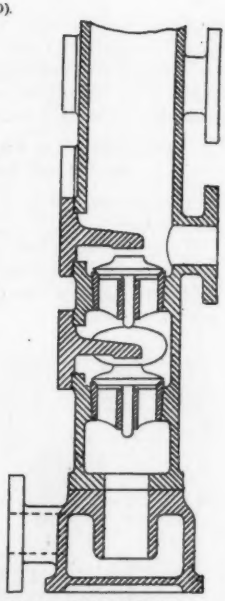


FIG. 11.—TRANSVERSE SECTION THROUGH COLUMN.

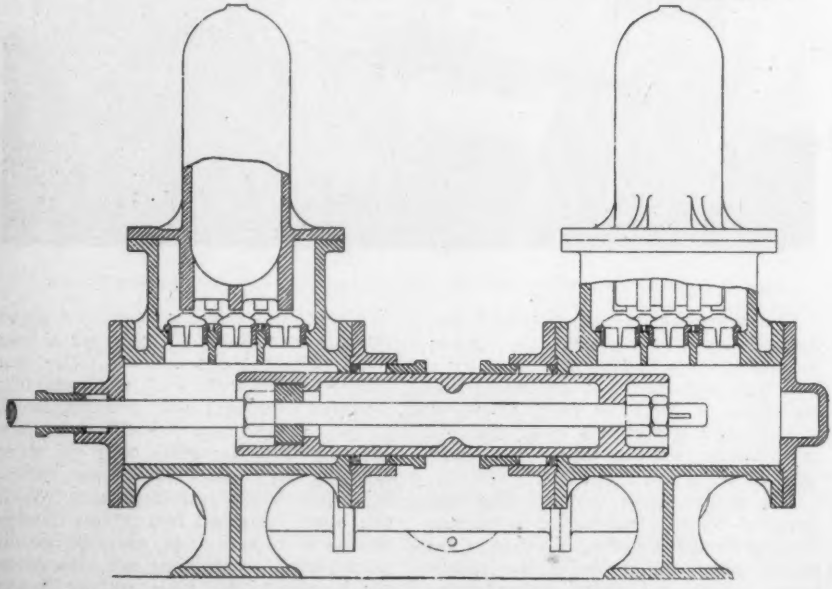


FIG. 12.—COPE AND MAXWELL'S DOUBLE-ACTING RAM PUMP.

expense and trouble in packing. The gland is guided at each end, and cannot be twisted by screwing one side harder down than the other, so any friction or wear due to such a cause is obviated.

ADVANTAGES AND DISADVANTAGES OF PISTON AND RAM PUMPS.

The advantages of double-acting Piston Pumps are:—

They take up a very small space.

Being double-acting, they give a more uniform delivery than the single-acting pump.

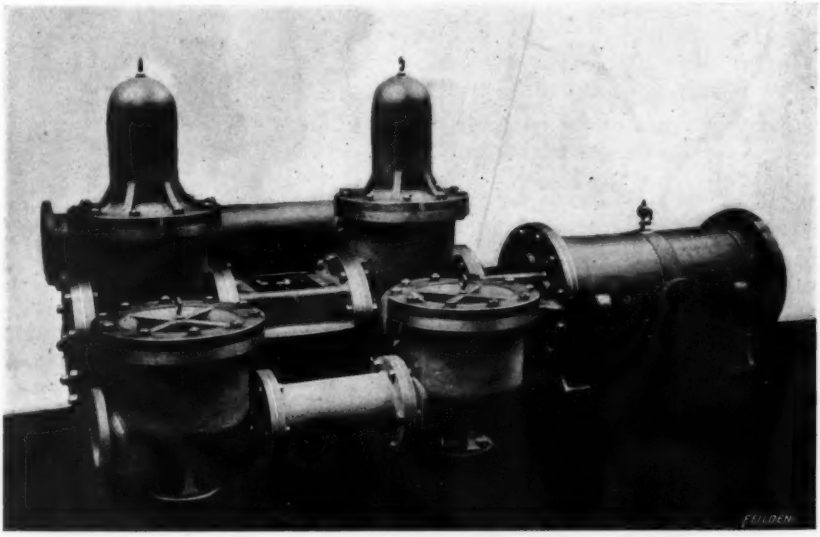


FIG. 13.—DOUBLE ACTING EXTERNALLY-PACKED RAM PUMP BY MESSRS. HAYWARD, TYLER AND CO., LTD.

The disadvantages of double-acting piston pumps are:—When the piston packing is worn, leakage may go on for a long time without being detected. The flat surface of the piston meeting the flow of the water. Usually a great distance or clearance between the suction and delivery valves and the piston.

The advantages of double-acting ram pumps:—There is less friction in the ram working through a stuffing-box than in the piston against the inside of the pump-barrel. When the water, generally the case in collieries and mines—is impregnated with sand, grit, mud, and other foreign matter, the wear and tear of the ram in horizontal pumps is prevented by the space underneath it forming a receptacle for the solid matter, which is not the case in the piston pumps. The cost of repacking the ram is only nominal, but the cup-leathers or other packing for the pistons are a great expense. The ram being packed from the outside, leaks are immediately detected, and the gland can be tightened in a minute while the pump is running, and the stuffing-box re-packed in a very short time; whereas, in a piston pump, a leak can be going on for a long time without being noticed. The ram can be lubricated, and the corroding action of acidulated water greatly reduced.

The disadvantages of double-acting ram pumps are:—The great body of water between the suction and delivery valves, consequently less perfect vacuum. With the inwardly-packed ram pumps there is the same objection as with the piston pump, namely, a leakage can take place for a considerable time without being

INSIDE PACKED DOUBLE-ACTING RAM PUMP BY MESSRS. HAYWARD, TYLER & CO.

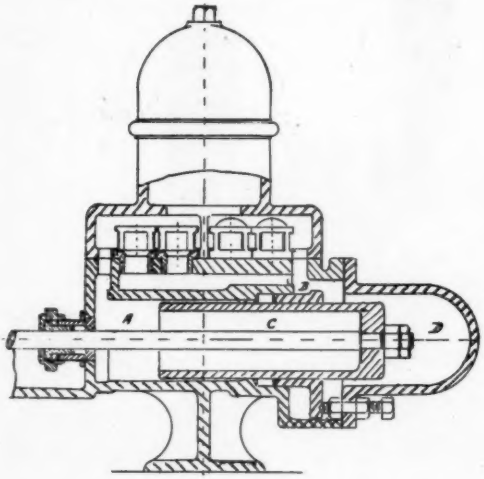


FIG. 14.—SECTIONAL ELEVATION.

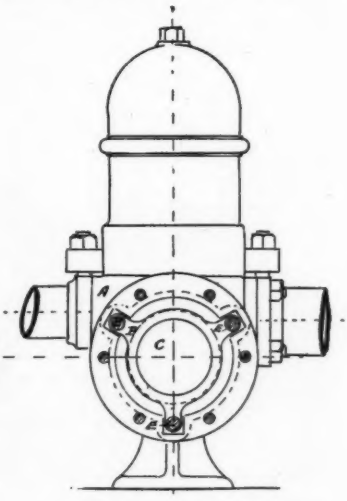


FIG 15.—END VIEW, WITH BONNET REMOVED.

THE KNOWLES EXTERNALLY-PACKED RAM PUMP.

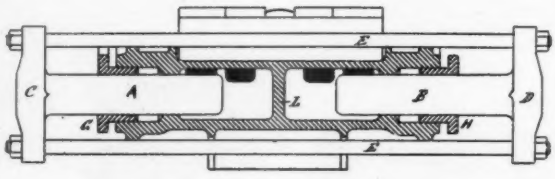


FIG. 16.—PART SECTIONAL ELEVATION.

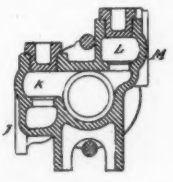


FIG. 18.—CROSS SECTION THROUGH ONE SET OF VALVES.

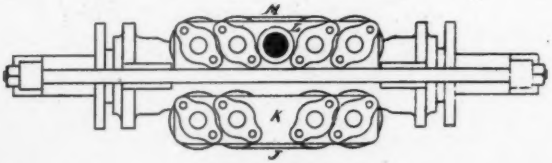


FIG. 17.—PLAN.

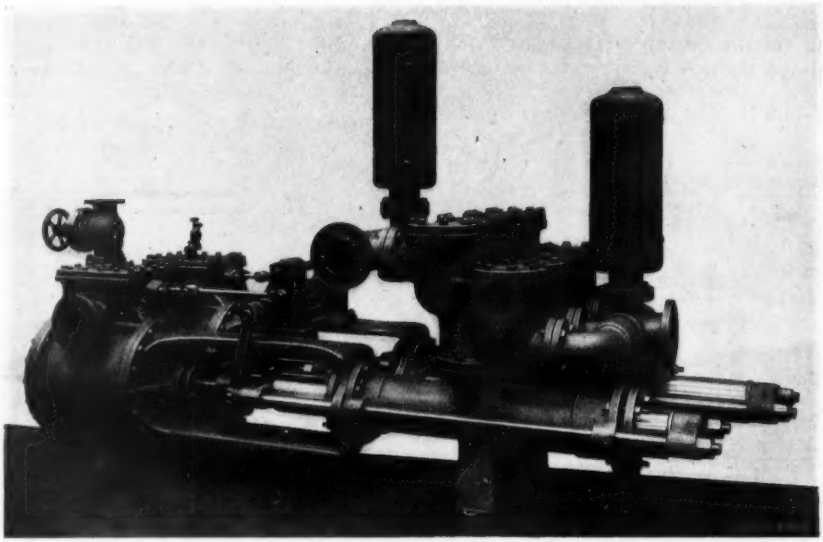


FIG. 19.—HIGH-PRESSURE DUPLEX PUMPING ENGINE BY MESSRS. FRANK PEARN AND CO., LTD.

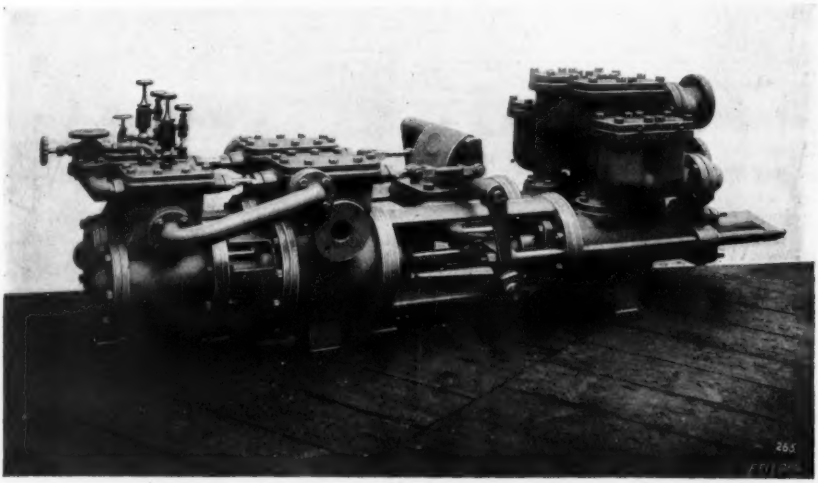


FIG. 20.—COMPOUND PUMPING ENGINE BY MESSRS. FRANK PEARN AND CO., LTD.

detected, especially when working against heavy pressures. However, we have seen rams that have been working many years without showing the least sign of wear or leakage.

From the above remarks it will be seen that the piston pumps are good when the space is small, when the water is clean and free from sand and grit, and the depth of suction is great.

The ram pump is best for sandy and gritty water, when the water is acidulated, and for very heavy pressures.

For extra heavy pressures, the best pump is undoubtedly the externally packed double-acting ram pump, illustrated in Figs. 16, 17, and 18. It will be noticed that in this pump the areas of the rams exposed to the pressure are perfectly balanced, the two rams being of exactly the same diameter, hence an uniform load is presented to the steam cylinder or pumping gear at each stroke. If we, for example, take a pump 6 in. diameter, 2in. pump-rod, and 800 ft. head to pump against, we get :—6 in. diameter = 28·27 in. area ; 2 in. diameter of rod = 3·14 in. area ; 800 ft. head = 346·4 lbs. pressure per sq. in. ; therefore we get on one side :

$$28{\cdot}27 \times 346{\cdot}4 = 9792{\cdot}728$$

and on the other side :

$$(28{\cdot}27 - 3{\cdot}14) \times 346{\cdot}4 = 8705{\cdot}032$$

making a difference of 1087·696

or nearly half a ton greater pressure on one side than on the other, which is very great, especially for the direct-acting pumping engines, which have no fly-wheels to compensate for the irregularity of the action.

There are several important points that should be looked to in designing pumps, which are too frequently neglected.

The first which must be considered is the efficiency of each type. This varies considerably, both on account of construction of the various details, the class of valve adopted, and the consistency of the liquid, fluid, or semi-fluid it is required to pump, also the depth of suction, for there are some designs that will give good efficiency with a shallow suction ; whereas this is very low when there is a great depth from the surface of the water to the top of the delivery valves. If we have two pumps, one piston and one ram, and both of the very best design and construction, the piston pump will draw the

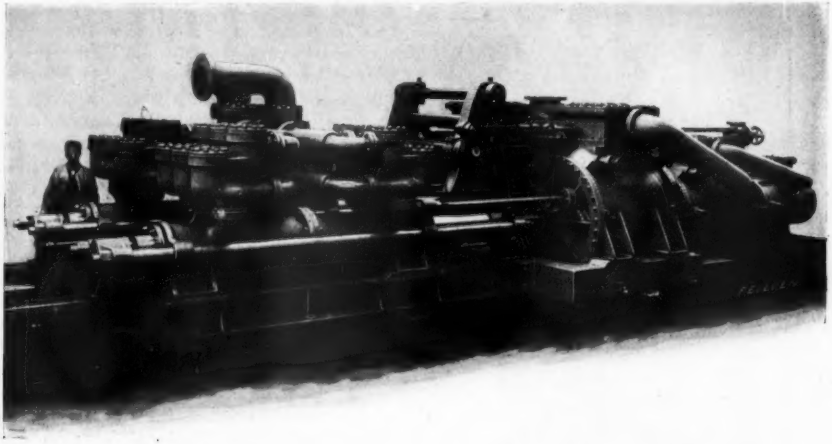


FIG. 21.—TRIPLE EXPANSION PUMPING ENGINE BY MESSRS. FRANK PEARN AND CO., LTD.

liquid from a greater depth than the ram pump, because there is less space for water inside the pump between the

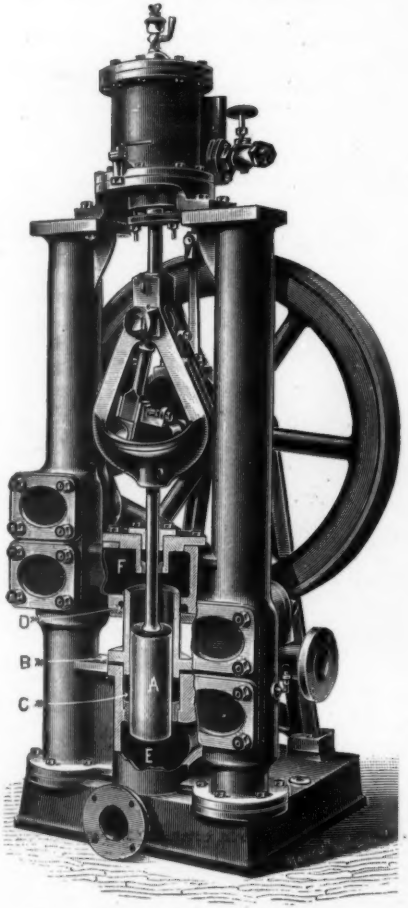


FIG. 22.—VERTICAL EXTERNALLY-PACKED RAM PUMP, BY MESSRS. FRANK PEARN AND CO., LD.

suction and delivery valves. This is a fact which has been much doubted, but the writer has proved it to his own satisfaction on several occasions by filling up vacant spaces inside the valve-boxes, and made projections on the pistons and covers, so as to reduce the clearance spaces to a minimum, and at once found a great deal of difference in power of raising the water from its source.

A PERFECT PUMP OF ANY DESCRIPTION

must comply, as near as possible, with the following rules :—

All valves and ports should be arranged so as to obviate the possibility of air lodging at any part, the air always rising to the highest point.

The various sections of the pump should always have, as near as possible, the same area, for the reason that when the area increases or decreases, the speed of the water is likewise affected ; consequently, a shock occurs when currents of different speeds meet. This cannot conveniently be carried out with horizontal pumps, therefore, the ports and passages should be kept the same area as that of the suction or inlet pipe.

All bends should have an easy curve, and all sharp corners should be avoided ; all passages should, when possible, be made round, because they create less friction and are stronger.

The under-side of the delivery valve-seat should be level with, or above, the top of the pump barrel.

The valve should never be allowed to meet a flat surface.

The ram or plunger should not be flat at the end, as is the usual way adopted in England and America, but made in the shape of a parabola or an ellipse.

Open-ended rams should always be avoided, because they increase the clearance space as much as the capacity of the interior of the plunger.

Philip R. Björling

Acetylene Generators.

By Professor VIVIAN B. LEWES.

(Part II.—*continued from p. 47*).

An acetylene apparatus that has met with considerable success is the one made by the Read-Holliday Acetylene Co., Ltd., of Huddersfield, who were amongst the earliest makers of generators in this country.

The type of generator is the same as the "Exley," and consists of a

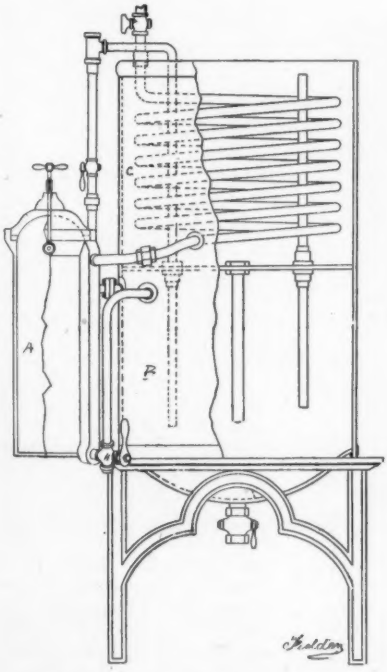


FIG. 12.—SECTIONAL VIEW OF THE READ-HOLLIDAY ACETYLENE GENERATOR.

generator A, Figs. 12 and 13, which contains a cage holding the carbide in connection with a displacement holder. Water is admitted to the generating vessel by opening the cock H, when water rising in A

FIG. 13.—EXTERIOR VIEW OF THE READ-HOLLIDAY ACETYLENE GENERATOR.

and coming in contact with the carbide generates the acetylene, which passes through a coil of pipe in the water cistern C, so that any excess of moisture brought over with the gas is condensed and runs back into the generator, whilst the acetylene passes on to the service pipes. Should any excess of pressure arise owing to over-generation, it forces the water away from the carbide and drives it back into the lower holder B; the excess of gas also passing through the same tube and collecting in B drives the water up the central tube into the coil cistern C.

In this way the tank B acts as a displacement holder, the pressure in which

increases with the depth of water driven up into cistern C, and as soon as the consumption of gas again exceeds the generation, the acetylene stored in the displacement holder passes through the generator to the outlet, being followed in turn by the water, which, on reaching the carbide, again gives rise to the evolution of a fresh supply of gas. This form of apparatus

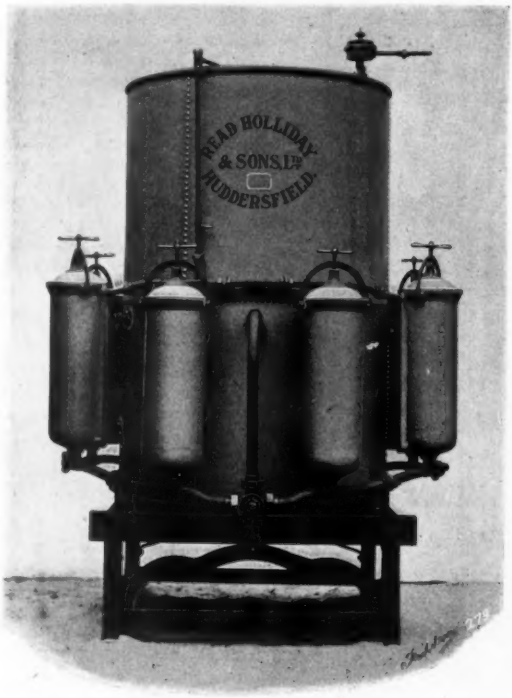


FIG. 14.—THE READ-HOLLIDAY ACETYLENE APPARATUS WITH MULTIPLE GENERATORS.

can of course have the generators multiplied (Fig. 14) to the required gas consumption, and is in fact made to supply installations of from 10 to 1,000 burners. In a large installation it is as well to use the machine in conjunction with an ordinary gas holder, but in many cases it is preferred to use a battery of the large size displacement holders with their attached generators, Fig. 15 showing a large installation of this character.

There are many occasions on which an easily moved apparatus is a great convenience, and Messrs. Read-Holliday, in order to meet these requirements, mount one of their small size machines (Fig. 16) on a carriage that can easily be moved to the required spot, as when a temporary installation of acetylene is required for a large marquee, for use on wharfs at night, or for other purposes of a similar character.

The "Thorscar" generator, as it is termed, made by the Thornton Scarth Automatic Lighting Syndicate, differs only from the "Exley" and "Read-Holliday" apparatus in detail, and like them consists of a vertical generator in which the carbide is placed in a cage subdivided into several compartments in which the water rises from below; and the gas then passes into a tank fitted with a rising gas holder instead of a displacement holder as in the two previous forms of apparatus.

Fig. 17 gives a section of the apparatus.

The action of the machine is extremely simple. The holder is charged with water, so that when it is resting on the bottom the water is above the level of the supply pipe leading to the lower part of the generator, and under these conditions the water flows down the pipe rising to the carbide and evolves the gas, which is led off by the outlet pipe to a small water dip chamber, which although it allows the gas to pass freely from the generator prevents any return taking place, this water lock or seal being a distinct advantage. Leaving the seal the gas flows on into the holder, which, rising, causes the water to fall below the level of the supply pipe, so that after a time the generation of gas ceases. As

the gas is drawn off for consumption the holder again falls, and having a displacement cone inside it, causes water to again rise to a sufficient level to flow into the carbide, this operation continuing automatically until the whole of the carbide in the trays of the generator is exhausted.

The subdivision of the carbide cage into several compartments, and the fact that a considerable surface of water is present at the point where the carbide is undergoing decomposition, tends to prevent overheating, and in the latest forms of apparatus the size of the holder is so arranged as to be capable of containing the full volume of gas made from the charge of carbide used.

This, of course, somewhat increases the size of the holder, but on the other hand does away with the risk of overheating which exists when the pressures during generation are at all high.

The gas passes through a small purifying box containing charcoal, which acts as a scrubber and removes condensation products from it, and the gas is also to a considerable extent washed in the water seal and in the holder. As the gas leaves the holder it is passed through a long coil of pipe contained in the water of the generator tank, any condensed liquids being collected in a catch box at the bottom of the apparatus, whilst the gas passes on to the purifiers, in which the traces of phosphuretted and sulphuretted hydrogen are got rid of.

FIG. 15.—BATTERY OF READ-HOLLIDAY ACETYLENE GENERATORS WITH LARGE-SIZED DISPLACEMENT HOLDERS.

Another acetylene apparatus closely allied to the Exley and Read-Holliday forms is that made by Messrs. William Bailey & Co., of Manchester, which consists of vertical exterior generators

containing the carbide, and a double compartment displacement holder in which the acetylene is collected and drives the water from the lower to the upper tank compartment, the pressure varying with the head of water driven into the upper tank. The generators with the particular arrangement of tubes and also the water cock *a* to one generator. The water flows in, the acetylene commences to generate, and escaping by the pipe *b* into the displacement holder, drives the water from it up into the reservoir *A*. This continues until the water has been driven below the water-inlet of the generator. As the gas is withdrawn the

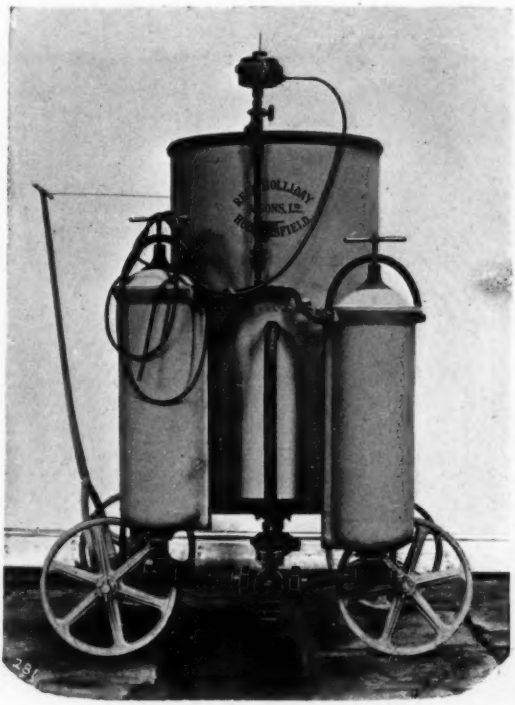


FIG. 16.—PORTABLE READ-HOLLIDAY ACETYLENE GENERATOR FOR TEMPORARY INSTALLATIONS.

adopted are shown in Fig. 18, whilst a section is shown in Fig. 19.

In using this apparatus, the outlet cock *D*, Fig. 18, is opened and the upper cistern *A* being filled with water, it flows by gravity into the gas receiver *B*. As soon as this is full and a depth of a few inches of water remains in cistern *A*, the stopcock *D* is closed and the gas cocks *b b* leading to both generators are opened water again descends from the tank to take its place, and rising above the level of the water inlet pipe of the generator again produces more gas. This goes on until the charge of carbide in one generator is used and the water level has risen to the top, when the water flows over through the gas outlet pipe into the second generator and there starts a similar action.

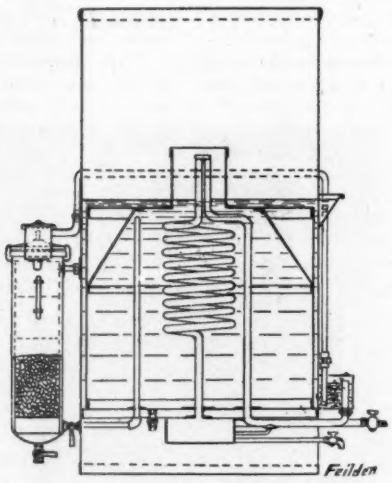


FIG. 17.—SECTION OF ACETYLENE GENERATOR BY THE THORNTON-SCARTH AUTOMATIC LIGHTING SYNDICATE.

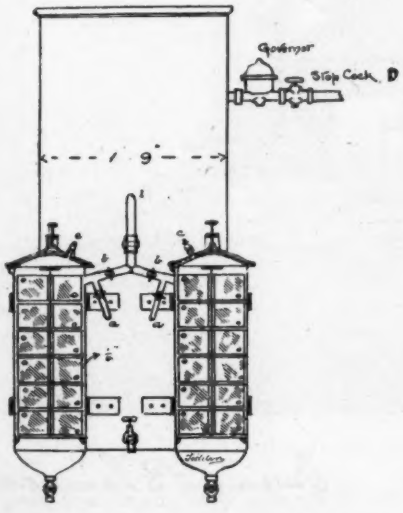


FIG. 18.—SECTION OF WM. BAILEY AND CO.'S ACETYLENE GENERATOR SHOWING TUBE ARRANGEMENTS.

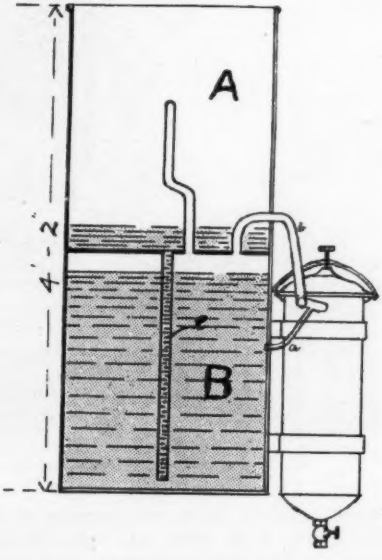


FIG. 19.—SECTIONAL VIEW OF WM. BAILEY AND CO.'s ACETYLENE GENERATOR.

All forms of displacement apparatus in which the pressure of gas varies from a few inches at the start up to a considerably higher point when the water has been driven into the upper tank, should be fitted with a regulator in order to ensure steady pressure in the pipes and burners.

Yet another vertical generator of this type, with automatic action, is to be found in the generator made by Hutton & Co. of Galashiels, and shown in Fig. 20, in which the generation of gas drives the water away from the carbide.

This firm also makes small generators of the same kind for drive lamps, which answer very well in cases where the lamp is so far from the house supply as to render its connection with the main installation inconvenient or too expensive.

FIG. 20.—HUTTON AND CO.'S ACETYLENE GENERATOR.

(*To be continued.*)

Vivian B Lewes

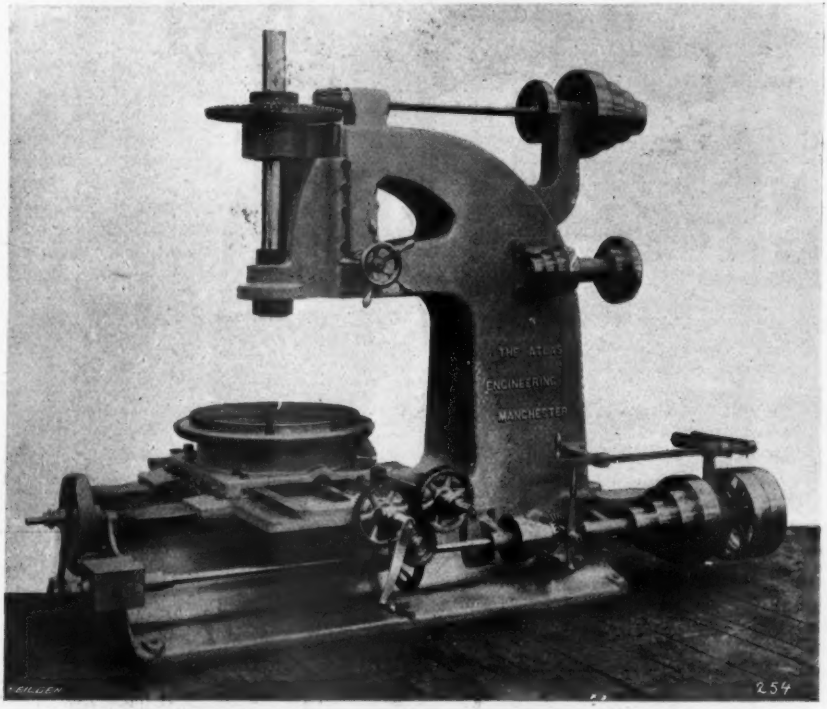
Machine Tools.

By EWART C. AMOS, M.I. MECH.E.

Further Considerations of American Competition.

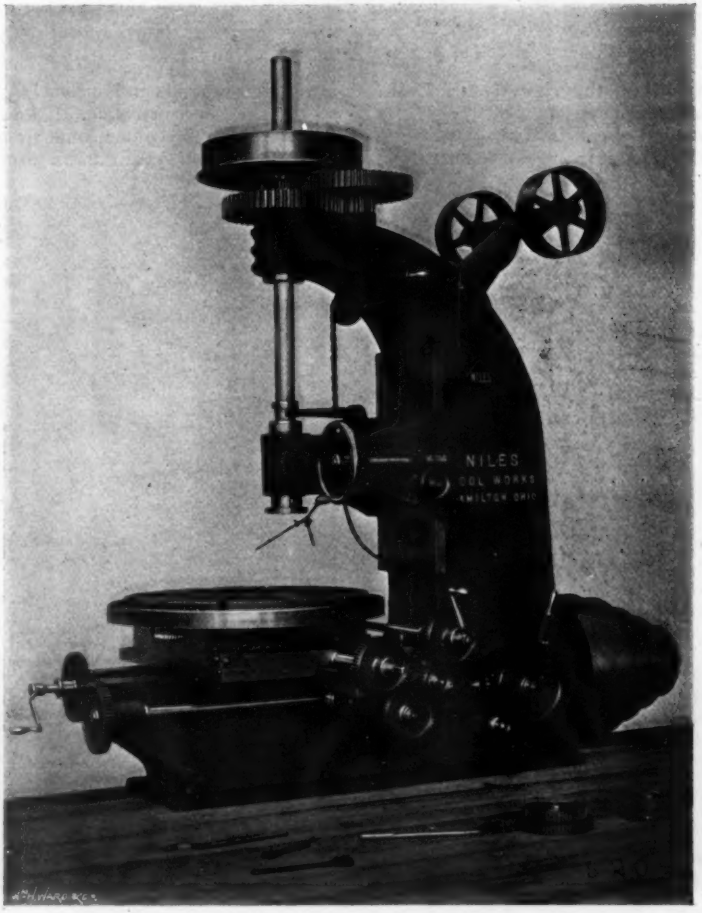
(Continued from p. 79).

So rapid are the changes which are taking place to-day in the design and method of construction of machine tools, that it is difficult to realise the point of perfection likely to be attained to in the next decade. One thing, however, is becoming strikingly evident, viz., that a great many ideas and practices long held to be correct and necessary in the past are being discarded and replaced by others of greatly superior value. Those who, like the writer, have for some time been urging British manufacturers to change their methods, in order to bring themselves into line with their successful American competitors, are looked upon as unpatriotic, and not seldom held responsible for advertising the foreign



MANCHESTER-BUILT VERTICAL MILLING MACHINE.

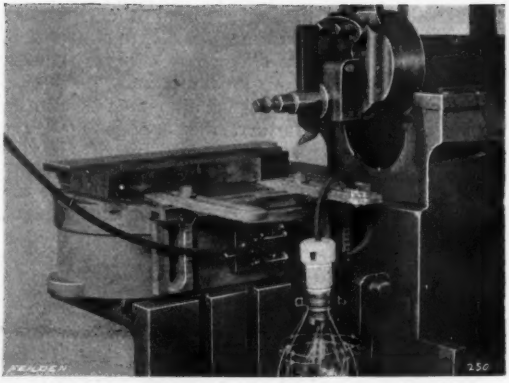
article, and at the same time doing injury to their own countrymen. This, however, is not correct, and those journals and societies which have lent themselves to a fair and open consideration of the case in



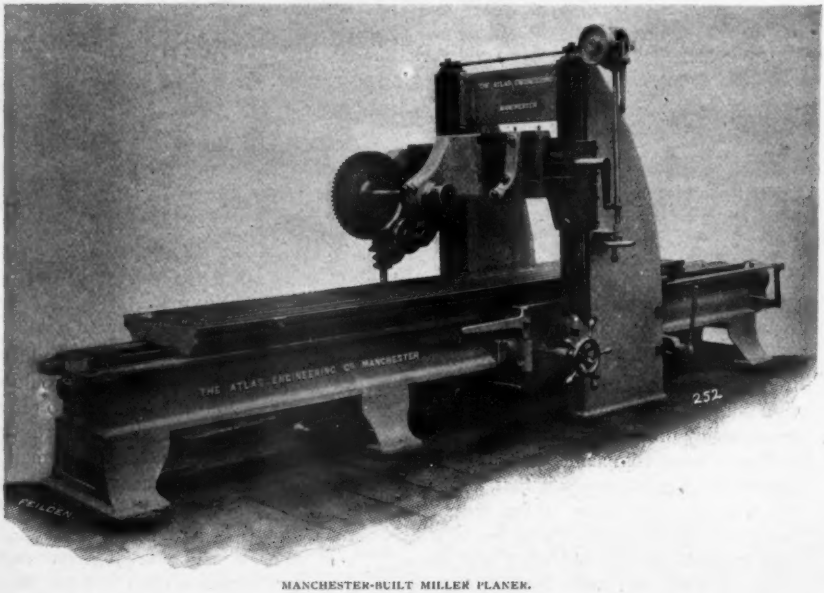
AMERICAN VERTICAL MILLER.

regard to foreign competition, are rendering to the British tool maker invaluable assistance, in spite of his opposition. The most successful firms to-day are those who have adopted the latest ideas with a view to turning out the most productive tools, because that is really at the bottom of the whole question, and the prime factor in America's success. They work on the lines that the prime cost of a machine is not necessarily an indication of its real value, and they have shown this to be so correct that they have persuaded the manufacturing engineers and machine tool users to pay prices for

machines that they never thought of paying a few years ago; and yet the high price paid has been more than returned by the increased amount of work turned out. To give an example of what is meant: supposing an English maker will supply a machine at a certain price, which machine is known to produce a certain amount of work, and an American firm comes along (generally through an English agent, by the way) and says, "We can give you a tool to do 25 per cent. more work, but we want 25 per cent. more for it,"—why, they get the order, and the user is largely benefited, since he increases his output without increasing his labour bill. These points are becoming so well appreciated, that there are few firms of any standing who have not got some American machines in their shops, and in many cases quite a number of them. And yet, notwithstanding all this, the English tool maker is, and has been for some time, crowded out with orders, and is consequently satisfied. How is it, therefore, that although he is getting all he wants, and more than previously, that the foreign maker is also reaping such a fine harvest? The answer may be



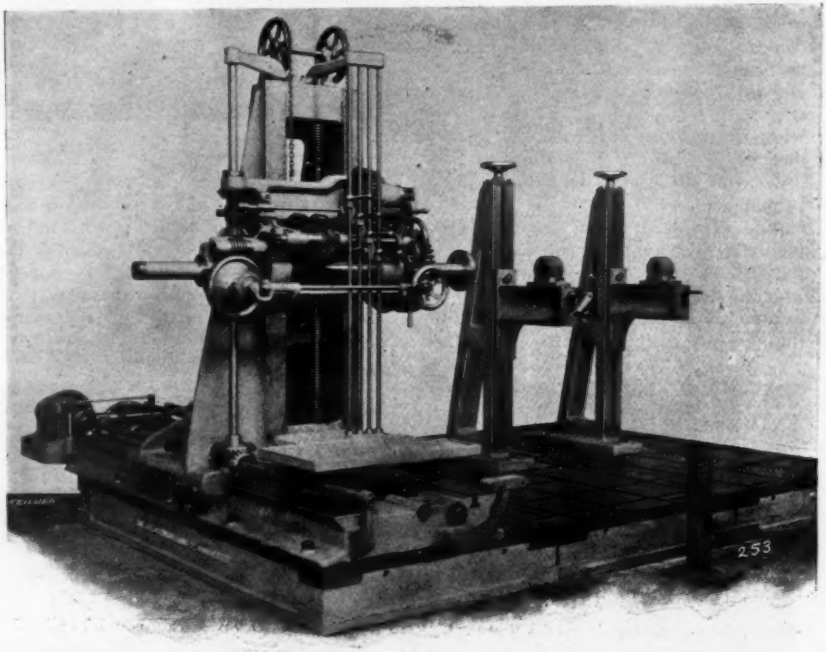
MAGNETIC CHUCK ATTACHED TO A SHAPING MACHINE.



MANCHESTER-BUILT MILLER PLANER.

found here, viz., that apart from the question of great engineering activity, the American makers have created a big demand for a number of special machines, many of which we have not yet attempted to make here, and further, the user is gradually awaking to the fact that capital sunk in machine tools is a very profitable investment. The state of the labour market has done not a little to bring this about, and where one man one tool becomes the order of the day, it is of the utmost importance for every tool to be as highly productive as possible.

But where complaint may be urged against the English maker is that, although he sees his competitor taking orders in large and increasing numbers, he is content to work on the old lines and on a class of tool that will before long be superseded. There are, of course, a certain number of firms who are alive to the necessity of making alterations in their designs, and, as already pointed out, these firms are doing excellent business, but they are comparatively few in number in relation to the whole industry. In making these statements there is no secret disclosed—it is only too well known to buyers and users of tools, and it is to their credit to say that they would buy the English machines if they could get them. Occasion will be taken to refer to this side of the question before these articles are concluded, but the remainder of this present article must be devoted to a description of several machines illustrated.

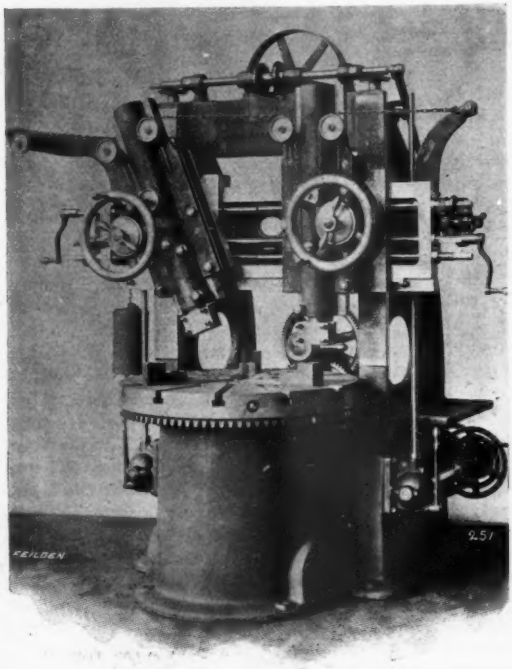


ENGLISH-BUILT UNIVERSAL BORING, DRILLING AND MILLING MACHINE.

A type of machine that is rapidly growing in favour is the

VERTICAL MILLING MACHINE,

and the two illustrations herewith show excellent designs of an English and an American machine. Whilst some comparison is possible, a close one is not, as the machines are of different capacity and size, the Manchester tool admitting 20 ins. in height and having a distance of 3 ft. from the centre of the spindle to the column,



AMERICAN BORING MILL.

whilst the American tool admits 26 ins. under the spindle, but only 24 ins. from the centre up to the column. The table in the American machine is 42 ins., against 30 ins. in the other, although the travel of the slides in the English tool is much the longer. Another essential difference in the two makes lies in the method of driving the spindle, the one by bevel gearing, the other by belt, with back gear for heavy work; both, however, it will be noticed, cause the lower bearing of the spindle to follow its travel with adjustment for wear. This is a class of machine where solid construction is desirable, and where English firms ought to excel.

In certain classes of work, and especially light work, the question of chucking, for the purpose of grinding, planing, shaping, milling, &c., is a somewhat difficult problem, and one, moreover, involving considerable expense relative to the value of the piece being machined. A little device which is here illustrated in connection with a shaping machine should go a long way to simplify matters. It is termed a

MAGNETIC CHUCK,

the principle employed being magnetism pure and simple; this is generated by an electric current circulating in a coil in the interior of the chuck; the body of the chuck however is not in the circuit, and there is no danger of shocks in handling. The mechanism is extremely simple, whilst there is also nothing to get out of order. The work is laid on the chuck as shown, a switch turned on, and the article is then ready to be machined. There is also provided a vertically adjustable magnetic back rest, which permits of either thick work or extremely thin work to be held, squared, and ground on the edges. Except in the case of hardened cast steel, the work itself does not become magnetised, and, in any case, a simple apparatus which the makers of the chucks supply very readily demagnetises the piece which has been machined.

Two more Manchester tools, as shown, require some description, and are examples of high class substantial machines. Taking the

MILLER PLANER

first, this machine will mill 10 ft. long by 2 ft. 6 in. square, and is very rigid. The design of the machine and its

motions are readily seen by reference to the illustration, but it may be pointed out that the spindle journal is 4 in. diameter with a 2½ in. diameter hole bored to a Morse taper. The cross slide can be raised or lowered by power, and the table has a varying self act in either direction with quick return. Other points as to driving, &c. are common to this type of machine. The machine described weighs 3½ tons.

In the

UNIVERSAL BORING, DRILLING AND MILLING MACHINE

will be found one of the most useful tools where much boring has to be done. This machine will admit in height from the work bed to the spindle from 1 ft. 6 in. up to 5 ft., and has a lateral traverse of the upright of 6 ft. with a self act feed to the spindle of 3 ft., the spindle itself being 3½ in. diameter. The bed is made up of sections 8 ft. × 4 ft. × 10 in., and can be enlarged at any time by the addition of one or more sections. The machine weighs 11½ tons, and is capable of dealing with a large range of work.

The

BORING AND TURNING MILL

shown is of American construction, and although similar machines are made in England, probably more come from America. It has been stated that this type of tool originated in England, was improved upon in America, and brought over here as an American idea. If that statement be correct it should cause no surprise, because it is being done in a good many cases, and it is likely that the Americans will be quite satisfied to let us have the honour of it so long as they get the business, about which there is no doubt. It is just these little improvements, this minute attention to detail, this putting upon the market of tools easy of manipulation and excellent in design, that has and is attracting our buyers. Moreover, even supposing the idea originated here, the improvements have played no small part in the ultimate success.

These mills, or as they are sometimes called, vertical lathes, are coming greatly into use, and occasion will be taken to refer to them more fully later on, when some English types will be shown.

The machine illustrated has a capacity of 37 in. diameter by 30 in. high, and has 16 changes of speed to the table. It is what is termed a double standard machine with two heads, each head or saddle being entirely independent in their movements, both as to direction and amount of feed, and the tool can be set at any angle. Either head can be brought to the centre for boring, and turning and boring can be carried on at the same time. In this make of machine the feeds are positive, with eight changes ranging from $\frac{1}{48}$ to $\frac{8}{48}$ in. horizontally, and $\frac{1}{64}$ to $\frac{17}{64}$ of an inch in angular and vertical directions.

Power motion is provided to raise and lower the cross rail, and the machine weighs over 4 tons.

(To be continued.)

Ewart S. Amos

A Revolutionising Innovation in the Glass Industry.

By LUDWIG GROTE.

MR. LUDWIG GROTE is a native of Germany, well known in connection with ceramics and glass work. He is the author of several inventions that have given rise to new industrial processes, and is President of the German Trades Club in London.

AMONGST the industrial arts which have been established for the promotion of the comfort and welfare of humanity, there is none whose products are more universally employed, or, in their way, more important in a commercial sense, than that of glass-making. Dwellings without glass-paned windows, and life itself without glass bottles or the thousand and one other applications of glass, can, in these days, hardly be imagined. The adaptation of glass in one form or another to a wide range of manufactures seems only to be limited by the scope of invention, and its utilitarianism, like that of paper, only recognises as its horizon that of human ingenuity.

While this is so, it is surprising to find that most common-place of articles, the ordinary glass bottle, though manufactured by the million, being made to-day in practically the same manner as obtained a thousand years ago, and though many attempts have been made to apply machinery to the manufacture of bottles, success has not hitherto resulted by these efforts. A life-long experience and earnest study of the technics of glass-bottle making has, however, suggested to the writer a method of imitating the mouth-blowing operation of the glass maker by mechanical means. Simple as this device may seem, the writer believes that it will bring about something like a revolution in the art of glass bottle-making.

THE HISTORY OF GLASS.

In order more clearly to appreciate the importance of the new departure, it may serve a useful purpose first of all to briefly trace the history of glass generally, and that of glass bottle-making in particular.

One must go back to the most remote ages in order to discover the first traces of glass—so far back indeed that one is forced to say that the origin of the same cannot be ascertained with any degree of certainty. The making of glass seems to have been discovered simultaneously by different peoples of ancient times, as may be seen from the ancient records handed down to us in ancient literature. Certain it is that the manufacture of glass was in a highly flourishing state some 4,000 years ago, amongst the old Phœnicians, and that those enterprising people brought the products of the glass-makers to all parts of the world known at that time. We therefore find, not only in the old giants' graves in the North of Europe, but also in the interior of Africa, relics of the productions of glass of that period.

The Roman historian, Plinius, tells us that the Phœnicians had by an accident discovered the making of glass through

some seafaring people who were driven to the coast of Ptolemais during a storm, and having prepared their midday meal on pieces of saltpetre, which, from want of stones, they placed together to form a provisional hearth, they discovered glass in the ashes after the fire had gone out. This statement, however, can only be regarded as a fable, as it is plain to our present day expert that the heat of an ordinary fire is not sufficient to bring about the smelting process. It would be even more easy to give credit to another story, that of Flavius Josephus, who ascribes the discovery of glass to the Jews, as the result of a forest conflagration, when with the assistance of the sand in the soil, the glass came into existence of its own accord.

As the Phœnicians and the Jews were neighbours, there is very likely an element of truth in both traditions, inasmuch as both people exercised the art of glass-making at an early age. If the Phœnicians were the first to carry the productions of glass into the world, by means of their traders, the Jews did the same, to a greater and more lasting extent. Amongst the latter there were whole tribes carrying on the making of glass. Most of the glass-works at that time existed on the coasts of the Mediterranean, and throughout the whole of the Middle Ages, even up to the present time, one kind of glass-blowing industry has been in the hands of the Jews, especially in Palestine itself. Many expressions which were common in the glass-works at that time are still in use.

But neither the Jews nor the Phœnicians can be looked upon as the inventors of glass. We find, for instance, that the Persians, at the time of Alexander the Great, were also drinking out of glass vessels; that the Assyrians were versed in the art of making glass, as we can prove by discoveries at Nineveh; and also that the art of making glass and of imitating precious stones, was known to the ancient Indians. Of great importance with regard to the history of the manufacture of glass are also the ancient Egyptians. When one remembers the great industrial activity of these people, it is not surprising that with reference to the making of glass, more numerous traditions of it are recorded by them than by any other people. Not only written, but also figurative representations which are more than 4,000 years old, have been handed down to our time. The wall reliefs in the groves of Beni-Hassan represent the manufacture of glass objects; they represent, amongst others, two glass-blowers at work. They are working with the blowing-pipe, which they have dipped into a mass lying between them, and by means of which they blow out a vase. What extremely beautiful glass was manufactured, even at that time, is proved by a crystal glass which is to be found in the Museum of the Louvre. The French, as well as the English museums, possess numerous artistic productions of that period, at the sight of which one is surprised, as in our time and with our mechanical appliances it is hardly possible to surpass them.

The Romans appear to have been the principal customers of the early Jewish glass-makers, and with the increasing luxury of that epoch, the manufacture of glass increased, as it was not limited to the production of smaller useful objects, but also extended to the building trades. That the manufacture of glass developed in an artistic sense to the highest point need not appear wonderful, with so extremely intelligent a people as the Romans. The treasures contained in the Museum of the Vatican, in the French museums, and in the British Museum, bear testimony to their accomplished workmanship. The famous "Portland Vase" in the museum of this city is probably the best proof of it. In the year 210 A.D. there were so many glass-blowers in Rome, that they had set apart for them their own quarter of the city. But with the fall of the Roman Empire came also the decline of the art of glass-making; with the extension of Christianity the glass industry gradually developed again.

In this way it was, centuries later, that Venice assumed the first place in the manufacture of glass, and may consequently be justly looked upon as the second mother of the glass industry. In the year 1291, the Venetian senate

compelled all glass-makers to transfer their works to the island of Murana, in order to confine the various secrets to as few persons as possible. The glass-making guild was given the most extensive privileges, and severe penalties were inflicted for any disclosure of the various processes. Old traditions abundantly prove how the Germans, throughout the middle ages, intrigued in order to obtain the secrets of the art of glass-making, and the high degree of excellence attained by the industry at those times in Germany, which takes to-day the very first place in the glass industry. It is Germany that is now furnishing the best, as regards quality, and the most as regards quantity.

Coming now to

THE MANUFACTURE AND CONSUMPTION OF GLASS BOTTLES

throughout the world, it may at once be said that the latter is almost incalculable. Germany, Belgium, Austria, France, and England are the principal producers, but whereas England and France manufacture

A DEMONSTRATION OF THE GLASS-BOTTLE BLOWING MACHINE.

can only serve to show that these people were at that time possessed of a high degree of intelligence. After the process of making glass plates had become generally known, the demand for window-glass and looking-glasses increased; but in the 16th century they must still have had a considerable value, for old chronicles show that in the year 1573 a certain duke, when he went on his travels, had his glass windows taken out in order to protect them. By degrees, the use of glass became more general, and glass-works sprang into existence in nearly all civilised countries; and it is Germany chiefly for their own requirements, and export them indirectly, *i.e.*, filled with wine, liqueurs, &c., Germany has an extraordinary export, much larger than that of all the other countries combined. If we compare the statistics of the year 1872 with those of 1897 we find that Germany exported in—

1872 .	494,428 cwts.,	or about	148,330,000 bots.
1897 .	1,892,060 ,,	,,	567,618,000 ,,

In certain districts, Germany is extremely rich in raw materials necessary for the manufacture of glass. The cheap railway carriage, and, still more, the excellent

water-ways make cheap transport to the seaports possible, and by this means greatly facilitate the export. Again, Germany turns out bottles which chiefly distinguish themselves by the uniform strength of their walls, and are, therefore, very suitable for highly sparkling contents. Attention is also paid to the perfect formation of the neck of the bottle, although up to the present (as will be seen later on) it has not been possible to make one bottle exactly like another, especially as regards neck and bottom. The exceedingly low price at which good German bottles can be supplied has enormously increased the export of Germany.

Austria-Hungary, on account of her great wealth in wines and mineral waters, requires an enormous quantity of bottles, and manufactures large quantities in Bohemia, Moravia, and especially in Styria, which, however, are not sufficient to supply the demand. She is, therefore, obliged to import from Germany. In France the position of affairs is much the same. England, especially, has to rely on imports. Here, it is the want of suitable raw material, and especially high rates of wages, which make the manufacture so difficult. America manufactures for her own requirements, which in the absence of reliable statistics it is difficult to ascertain exactly. But in any case the demand is an enormous one, and large quantities are imported every year from Germany. The glass bottle trade of Germany with foreign countries has, indeed, increased to such an extent that the export is eight times greater than the import. Of the 94,603 tons of glass bottles exported from Germany in 1897, Great Britain absorbed 28,276 tons.

According to a reliable computation, the annual requirements of the principal countries of Europe represent 1,925,000,000 bottles, of which France demands 350,000,000 and England 250,000,000. If there be added as the supposed requirements of America, 200,000,000; those of Japan, 20,000,000; and of China, 10,000,000, we arrive at the amount of nearly $2\frac{1}{4}$ *milliards* of bottles which are being used annually. All these bottles have, up to the present time, been produced *by hand through the lungs of the glass blower*.

In dealing now with the manufacture of glass bottles, as up to now carried on, it will be unnecessary to describe the preliminary production of the glass itself. A description of

THE PROCESS OF GLASS-BLOWING

may, for the purpose of the present article, commence when the red-hot, or rather, white-hot, mass of glass is taken from the furnace to be blown out. This is done by means of a pipe—the so-called glass maker's blowing-pipe—which has been in use for 4,000 years. There is a mouthpiece on the upper end of this pipe, and on the lower end, which is of a conical shape, there is a smaller opening, which gets somewhat wider towards the middle of the pipe. This pipe is dipped into the so-called port or furnace, which contains the fluid or molten mass of glass. The mass of glass settles in the form of a lump of molten glass around the pipe, which is then taken out and held into the air, by the glass-blower, like an ancient trumpet, and blown, so that there comes into existence a bubble, large or small, according to the size of the bottle one wishes to make—on the principle of the soap bubbles which children blow out by means of a clay pipe.

This done, the glass-blower lowers the end of the pipe and the glass bubble takes an oblong shape, which, by constant turning on a working table of stone or iron, is made round. This procedure is called the "marbling." When the marbled mass has obtained the approximate length of the intended bottle, the glass maker places it into the "form" or mould, which he closes by means of the foot-lever. He now blows out the bottle with full force, opens the form and takes out the red-glowing bottle in order to put on the neck. For this purpose his assistant holds the bottle for him with the tongs, whilst the glass-blower catches up a fresh lump of molten glass, which he affixes to the headless bottle. For this operation three workmen are required, who, in nine hours, produce about 800 half-pint bottles.

From this it will be clear, even to the

layman, that the work of a glass-blower is by no means an easy one: he is obliged to work constantly standing at the hot urnace, and to exercise his lungs to the utmost extent. If one further takes into consideration that the gases which are produced during the process are also detrimental to health, it may be considered as a matter of no little importance that a machine has been invented which considerably facilitates the work of the glass-blower. The idea of cheapening the production has, as a matter of course, led those interested to think of inventing machines as substitutes for the human labour. The statistics of the German Empire alone show that in the years 1877 to 1897, 428 patents for this purpose were granted. In proportion to other branches of industry, this is, of course, a small number. All these patents were intended to solve the question, and the inventors deserve every credit for their ingenuity and labour. Inventors in other countries have also laboured in a similar direction; and the result of all this is that the writer has had to study more than 1,000 patents, which distributed themselves over a period of 250 years, in order to avoid coming into collision with one or other of these patents. There is not, however, one amongst all these patents which will produce a machine capable of furnishing useful bottles, or which had attempted to solve the problem of

IMITATING BY MECHANICAL MEANS THE ACTION OF THE HUMAN MOUTH IN BLOWING A BOTTLE.

The writer claims that his machine has solved the problem. It has already been mentioned that the glass-blower takes out of the furnace a quantity of the mass of molten glass which he *thinks* sufficient. As this, however, is guess work, it is obviously impossible for him to blow each bottle uniformly, as it cannot be controlled in any way. Further, as also mentioned, the formation of the neck of the bottle is extremely difficult, so that very frequently the neck is broken when the bottle is nearly finished. The manufacturing process under these circumstances results in excessive waste. Now by means of the new machine, bottles of a faultless

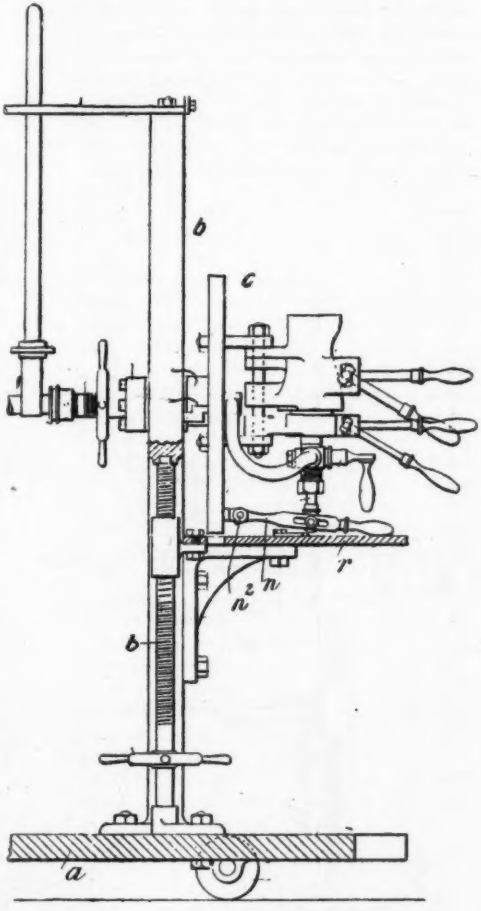


FIG. 1.
SECTIONAL ELEVATION OF GLASS-BOTTLE BLOWING MACHINE.

shape, and, what is more important, of uniform weight, are produced, and that with little or no waste.

These advantages are obtained by first using the form or mould only as a measuring form, and then, after turning round and opening the same, the lump of molten glass is worked at its lower end with a spoon, while an injection of air completely imitates the former blowing out with the workman's mouth.

Referring to the accompanying diagrams, Fig. 1 is a side elevation of a glass-bottle blowing machine with the neck mould clasped on to a moulding on the air admission device, and the measuring mould clasped on to the neck mould. The preliminary mould thus formed is shown inverted ready to receive the charge of molten glass. Fig. 2 is a view of the same machine with the measuring mould and neck mould reversed. Fig. 3 is a front view in elevation of Fig. 2, showing the measuring mould open and laid back and the molten mass of glass held by, and depending from, the still closed neck mould. Coming next to the details, Fig. 4 is a "local" front elevation (*i.e.* at right angles to Figs. 1 and 2) showing the final body mould placed in position round the partly formed bottle and clasped on the neck mould. Fig. 5 is a view on an enlarged scale of the measuring mould (inverted) clasped to the neck mould, and Fig. 6

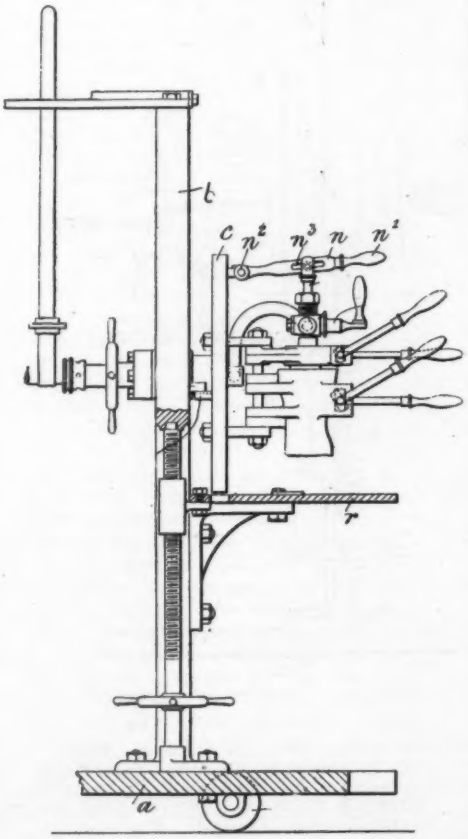


FIG 2.—SECTIONAL ELEVATION OF GLASS-BOTTLE BLOWING MACHINE WITH THE MEASURING AND NECK MOULDS, REVERSED.

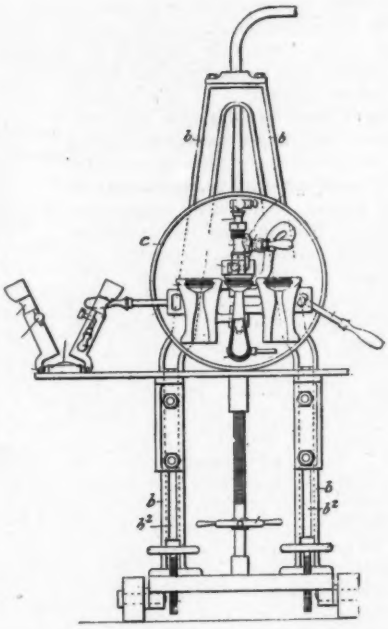


FIG. 3.—FRONT VIEW OF GLASS-BOTTLE BLOWING MACHINE.

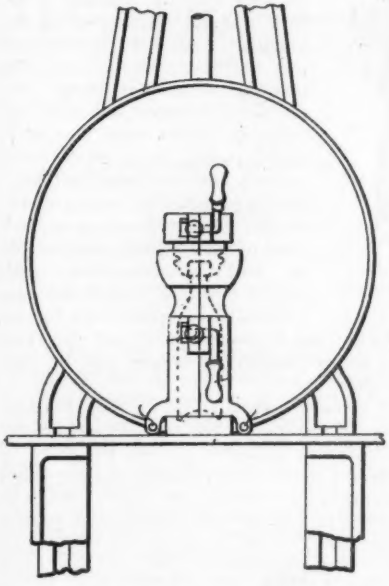


FIG. 4.—PART FRONT ELEVATION SHOWING FINAL BODY MOULD IN POSITION.

is a diagram of the partly formed bottle showing the "spoon" by which the bottom of the molten glass is manipulated. Fig. 7 is a view of the partly formed bottle after manipulation by the spoon. Fig. 8 is a view showing the finished bottle having a flat bottom thereto with the central part of the bottom raised to form the "kick-up." Fig. 9 is a "local" vertical cross sectional view of the neck-mould and plunger—the latter in position to form the depression in the upper end of the mass of molten glass depending from said neck-mould. Fig. 10 is a longitudinal vertical sectional view—on a greatly enlarged scale—of the air admission mechanism with the plunger and plunger chamber or device through which said plunger or regulating rod is adapted to slide, showing the air admission cock wide open. Fig. 11 represents the air admission valve partly closed, and Fig. 12 the air admission valve very slightly open.

In Figs. 1 and 2 there is first the frame to be noticed, consisting of two equal parts, *a b*, connected by means of a movable hollow axle, which is connected with the compressed air drum. On each side of this axle (Fig. 2) there is a form affixed to a revolving disc, *c*. This form, in its turn, consists of two parts, which may be opened whilst, independently of the same, the principal form or mould stands on a working-table, *r*, affixed to the frame, *a b*. In this principal form the bottle is completely blown out. Below the form, affixed to the movable disc, there is a cock by means of which the introduction of air is controlled. In the interior of this cock there are bevellings on both sides of the body of the cock, through which the compressed air is forced to enter gradually into the form in a circuitous direction. In this manner the blowing with the mouth is imitated in the most natural way.

The air introduced from the compressed air drum is again regulated, shortly before entering into the part of the neck-mould forming the neck of the bottle, through a hollow pipe, which is affixed in a suitable middle piece in the interior of the neck-mould. In the middle of this pipe there is a tongue which can be displaced by means of a lever, *n*, and which is smaller in its upper part, so that on its lower end arises a partition, which cuts off the air before it enters the pipe. Through the partition being made weaker at the upper end, there arises an intermediate space between the pipe and the tongue, through which the air can penetrate, after the

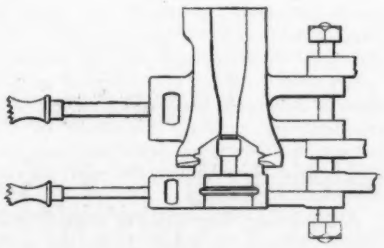
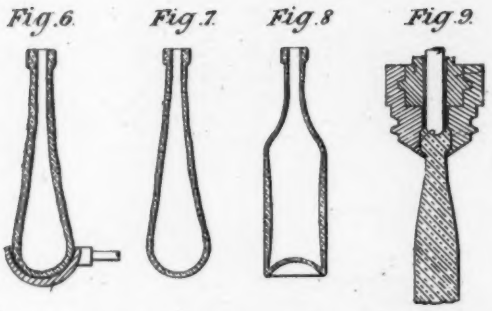


FIG. 5.—THE MEASURING MOULD.



THE MACHINE-BLOWN BOTTLE IN ITS VARIOUS STAGES.

THE NECK MOULD AND PLUNGER.

tongue is withdrawn, into the mass of glass, for the purpose of the up-blowing.

Just as the tongue is withdrawn by means of the lever more or less out of the neck-mould, so the air will penetrate more or less at first into the hollow pipe, and thence into the mass of glass near the partition of the tongue, so that, by means of the cock with its bevellings in the interior, as well as by means of the arrangement of the pipe with the tongue, the introduction of the air can be regulated in the most exact manner.

THE MANUFACTURE OF THE BOTTLE BY THE NEW PROCESS

is brought about in the following manner: The measuring mould (Fig. 5), which has been made correspondingly smaller, is first of all filled with the mass of glass. By this means the great advantage is gained that for each bottle an exactly equal quantity of the mass of glass must be used. The neck mould is then turned round and the measuring mould below the same opened, in consequence of which the lump of molten glass, which is still connected with the neck form (closed for the present), hangs down freely. This lump of molten glass is thereupon worked, for the purpose of obtaining a better formation of the bottom, with a spoon, described later on, and is then blown out in the open air and free from the mould.

At this stage the finishing mould mentioned already is taken from the work table and hung on to the neck-mould and shut, so that it entirely closes in the lump of molten glass. As soon as, after the opening of the cork and the withdrawal of the tongue, the air has entered into the finishing mould, and the bottle is completely blown out, the same is taken off with the finishing mould from the neck-mould, after both have been opened and have been put aside for the purpose of cooling down. As this cooling down takes place outside the machine, it is possible to work simultaneously with several finishing moulds, whereby (especially compared with former times) much time is saved, and therefore a larger number of bottles can be produced

It now remains to describe more fully the use of the spoon (Fig. 6). As soon as the measuring mould is opened, the lump of molten glass has an oblong shape, which is not quite round on the lower end. In order to give this part (the bottom part of

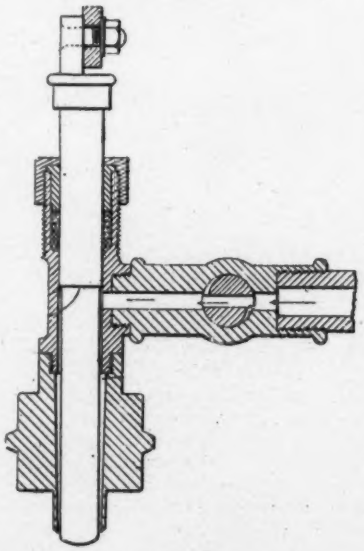
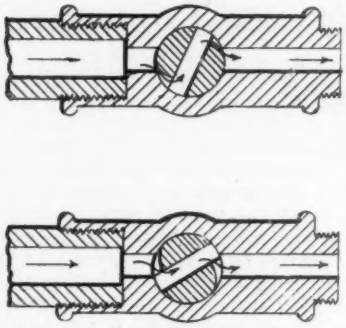


FIG. 10.
VERTICAL SECTION OF THE AIR ADMISSION APPARATUS.



FIGS. 11 & 12.—THE AIR ADMISSION VALVE PARTLY CLOSED AND PARTLY OPEN.

the bottle) the right shape, the round-shaped spoon, the inner surface of which is quite smooth, is used to work gently the end of the lump of molten glass from all sides, whereby the bottom is uniformly made round. In this way the formation of lumps, which frequently occurred formerly, and principally caused the waste, is obviated, and if any inequalities already exist they are equally distributed, and any cracks or hollows are rectified in a satisfactory manner, without the mass being pressed asunder on the sides. This treatment of the lump of molten glass is commenced when it begins to sink by its own gravity. There is sufficient time until it sinks to the desired length for the careful execution of this work, apart from the fact that this special treatment of the bottom of the bottle carries with it the formation of this part of the bottle quite free from corners and edges. If one thereupon takes off the spoon the heat of that part of the lump of molten glass, which is still glowing red at the top, will, without hindrance, be communicated to the lower part, which has somewhat cooled down, so that the completion of the bottle is brought about quickly.

While, by this time, only the lower part, the so-called "kernel," remains cooler, the temperature of the bottom mass has increased in all directions. If, then, sufficient use be made of the finishing mould, the coldest part of the bottom of the bottle gets placed on the top, above the raised part of the bottom of the finishing mould, without however being able to draw asunder or crack. But the greater part of the lump of molten glass will, in consequence of the force of gravitation, sink down to the edge formation of the bottom of the bottle. This treatment acts in the opposite manner to that which has been in use up to the present, for formerly the thick, inner part was the hottest, and the edge part was the coolest and most brittle, so that the formation of the edge of the bottom of the bottle became difficult, whereas by the new process the formation is considerably facilitated.

After what the writer has recapitulated, he believes it will be appreciated with what justice he claims to have solved the question which has caused so much mental effort and worry to hundreds of experts, namely, the mechanical imitation of the work of a bottle blower. For one thing, work at

THE GLASS-BLOWING MACHINE IS IN NO WAY DETRIMENTAL TO HEALTH;

for another, it complies with the demands of the present time, namely, to produce large quantities as cheaply as possible. By this machine, working capacity is more than doubled, and labour is considerably reduced, so that a saving in the production of more than 50 per cent. in comparison with the former process is obtained. It may also be added that a demonstration of the machine was made some time ago at a glass works at Hackney, London, and the illustration on page 205 refers to that occasion, when many owners of glass works in England and elsewhere were present.

Ludwig Grote

Engineering in Britain and America.

By TOM MANN.

MR. TOM MANN was born at Foleshill, near Coventry, in 1856. From 1866 to 1870 he worked down the mine at Foleshill and on the pit bank. From 1870 to 1877 he served an apprenticeship at Birmingham at the works of the well-known firm of Messrs. Thos. Chatwin & Son, Engineers and Tool Makers. Coming to London in 1877, Mr. Mann worked at various engineering shops on and off for 10 years. In 1883 he visited the United States, in order to get an intimate practical acquaintance with the work in American engineering establishments, and, on returning again to England, he worked as journeyman in several London engineering shops, also for a short period in Tyneside engineering works. Mr. Mann has been President of the Dockers' Union since its formation in 1889. He was the first Secretary of the London Reform Union and a member of the Royal Commission on Labour, 1890 to 1893. He has also held the office of President of the International Transport Workers' Federation from its formation in 1896 to the present time. Mr. Mann, as is generally known, has aspired for Parliamentary honours on three separate occasions, but in each case, in spite of indefatigable exertions, was unsuccessful. At the General Election of 1895, he stood as Labour candidate for the Colne Valley Division of the West Riding of Yorkshire, the Liberal candidate being Sir James Kitson, who was returned. In April, 1896, Mr. Mann stood as Labour candidate for North Aberdeen, vacant by the death of Dr. Hunter, his opponent being Captain Pirie, who was returned as a Liberal. On the third occasion, the subject of our sketch stood as Labour candidate for Halifax in March, 1897, when he was opposed by Mr. Billson, Liberal, and Sir Saville Crossley, Conservative, the former of whom was elected. Mr. Mann has done yeoman service in the cause of the working man, and though his outspoken utterances have not always, perhaps, been of a nature which employers of labour could consistently fall in with, no one will doubt his sterling qualities and the genuine and conscientious spirit with which he has invariably been animated. As a contribution to industrial-engineering literature, at a time when so much attention is being directed to foreign competition, his article which follows, will be read with interest.

THE stimulus that has been given to the old discussion of international trade competition has aroused special interest in engineering circles, and the fact that several British railway companies have ordered locomotives from the United States, that the Egyptian Government are obtaining bridge material from America, and that Germany has built and engined some first-class passenger boats, has given rise to a cry of alarm on the part of some of the writers on the subject, that seems to me in a degree unwarranted.

Some persons seem to hold the view that

BRITAIN OUGHT TO BE INDUSTRIALLY SUPREME

in every department, and are disposed to

grumble when they find that although we have an enormous trade, in shipbuilding for instance, she does not at the same time grow corn sufficient to feed our whole population, and cattle enough to render the importation of American produce unnecessary. It seems necessary to tell them that if Britain becomes entirely, or approximately, self-sustaining, other countries must take the same course, and international trade proportionately drops. Neither Britain nor any other country can have, or ought to have, a monopoly of the world's trade; such a result, if it could be realised, would bring about discord and social disorder of the most serious kind, industrially enslaving the nation of toilers and checkmating legitimate and necessary development on the part of the nations who did not perform their share of work.

For the average citizen the chief question is, having regard to the total trade of the world—has Great Britain her full share for her forty millions of population? The reply to this is, undoubtedly, Yes. The statistics show it, and observation and everyday experience confirms it. Even so, it is admitted that Britain, that has hitherto been the first country in the world in engineering, does not appear to be able to claim that title now, and it becomes necessary to ascertain why.

Sixteen years ago I was working as a journeyman engineer in a London shop that had then, and has continued to have to the present time, a considerable number of orders from British and other Governments, but whose machinery was of a very antiquated type, and although suggestions were made by workmen to the foremen, no change was made in favour of newer types. For years prior to this I had noticed the

STEADY BUT SURE INCREASE OF AMERICAN TOOLS

in English engine and machine shops, and had been impressed with their accuracy and neatness and elegance of design. I kept careful watch of all get-at-able statistics bearing upon the engineering and shipbuilding output of the various countries of the world, and anything that caused Britain to appear to be losing caused me considerable concern, and the continued increase in American milling machines, lathes, and small tools, had such an effect upon me that I gave up my job in London and made for New York, in order to study the subject on the spot. I was lucky enough to get a place the second day after landing in a considerable-sized works, that brought me in contact with exactly what I wanted, and my surmises were confirmed on all hands. The first thing to strike me was this—to me a most interesting item: I found that a large proportion of the most responsible positions in American engine and machine tool shops were held by Englishmen or Scotsmen. It mattered not what general opposition there might be to trades unionism as an institution, I saw that American employers—who, by the way, are always experimenting—when they required a few specially reliable skilled men, turned with confidence to members of the Amalgamated Society of Engineers, who had, of course, been through the English workshops. I also observed that although the usual reluctance to granting a general increase of wages or reduction of hours characterised American employers, they most readily paid a generous wage to the men I have referred to, and who, whilst they had comfortable and interesting situations, were large contributors to the success of their respective firms. Indeed, I formed the opinion then, and I believe it still true, that the love of experimenting which, as far as I could learn, characterised a large percentage of the American employers, and their securing a highly skilled group of men, whom they paid well, and treated with confidence, was and is a

POTENT FACTOR IN AMERICAN MACHINE-MAKING PROGRESS.

I have worked for sixteen years in English engine and machine shops, and in the whole of that time I saw less friendly consultation between employers and employed than I saw in America in sixteen weeks. The English employer seems to fear a loss of dignity if he were to elicit an opinion from any one of lower rank than the manager or chief draughtsman. The American trots out every hour or so, and has no scruple in going to any workman

who may be engaged upon, not the employer's idea only, but that of the employer, manager, draughtsman, mechanic and labourer alike—all gathered in the most direct fashion warm from the brains of the men engaged in the business, or indeed from any available source. Nationality aside, I said then and I say now, such behaviour deserves to win. It is nonsense to pretend that the British mechanic is inherently incapable, as some appear to think. Englishmen go to the United States, and without five minutes' hesitancy feel at home in the American shops, and begin at once to contribute materially to the making of machinery of greater efficiency than that they helped to build in "the old country." It all hangs on environment; and we have had an abundance of experience to show that if workmen are treated as reasoning beings whose opinions are valued when given, the result is vastly different to that obtained where they are looked upon as machine appendages. I am not of the opinion that America is a paradise for workmen. I know something of the large proportion of unemployed they so often have, and the terrible stress that prevails over large sections of the populace, in all respects as bad as that we are familiar with in Europe; but, dealing with the position and prospects of American machine-making and its bearing upon the trade of Britain, *the chances for the next decade are distinctly in favour of America*, and that because the customs here in England are so deep-rooted, operating against joint effort of employers and employed to the extent to which it already prevails in America. No one, however, should require to be told that, in spite of everything to the contrary, Great Britain and Ireland are still

THE WORLD'S CENTRE FOR SHIPBUILDING AND MARINE ENGINEERING,

and no one will doubt the engineering capacity of a nation of 40,000,000 only, and who yet build and engine more than half of the vessels of the whole world. Young America and old Germany have a fine "long row to hoe" before any material difference can be made in the present proportionate output; there is no doubt at all that British ships and engines are the envy and admiration of every country in the world.

It is not, however, the marine engine or locomotive builder, or both combined, that is calculated to have so revolutionising an effect upon the world's industry as the maker of machine tools. The most effective tool, that is *the tool that will turn out the greatest possible product with the least expenditure of energy*—this is what the world is calling for, consciously or otherwise, and it is precisely this that the Americans have been preparing themselves to supply. From Providence, Rhode Island; Fitchburg, Mass., and other American tool-making centres, there is a continual importation of tools and machinery that formerly came only from Manchester, Leeds, or some other portion of Britain.

In explanation of this, I have referred to the difference of attitude of the American employer towards workmen contrasted with that of his British compeer, to the detriment of the latter. I do not intend to convey the idea that the British mechanic is everything that may be desired, and that all fault lies with employers; it is no doubt the case that in Britain all sections are relatively slow to move as compared with the United States. Statesmen, employers and workers alike are terribly slow at getting out of old ruts. Political power has been used to "keep the masses in their place," to emphasise social distinctions, to make it unmistakably clear that between the rich and poor there is and ought to be a great gulf, no measure of a democratic character ever being conceded until it is plainly seen it would be too troublesome to longer withhold. After six centuries of this, it is not very surprising that we find so little co-ordination for national efficiency.

English employers have resented rather than encouraged any

PROPOSALS FROM WORKMEN,

so habitually, that a man would stand a good chance of losing his situation if he had the temerity to make a suggestion. "You are not paid for thinking, but working," has been the reply so often that only an ignoramus could express

surprise that helpful suggestions are not more frequently forthcoming. Some years ago I was working as a "turner" in a London engine-shop—almost exclusively on brass work—some American turret-lathes with special chucks and chasing-bar with "drag," instead of the usual "guide screw," on which it was quite easy to do *six times the amount of work*, with jobs for which the turret-lathes were suited, as could be done on the ordinary lathe. Subsequently I worked in several other shops in London, in each of which there was a considerable amount of work for which the special lathes were adapted, but having lathes of an ancient type—twenty years old some of them; this practically obsolete stuff was allowed to occupy shop room with a proportionate output of work. Similarly the universal milling machines were applied in one or two instances, but the greatest reluctance was shown by employers to clear out, as they might have done, several shaping and slotting machines, in favour of a milling or profile machine. This slowness was not in any degree traceable to opposition from the men, for although it would have meant one man doing as much work as several had been doing before, all that the "Society" men asked was, that the men employed on the special lathe or machine should receive at least the standard rate.

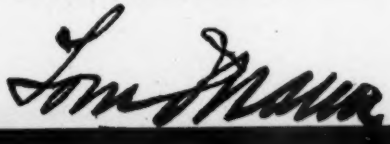
I firmly believe that the unwillingness to have changes in the machine shops has been stronger on the employers' side than on the men's, and as a twenty-years' member of the Amalgamated Society of Engineers, I can positively declare that an overwhelming majority of the members of that organisation have no opposition to the introduction of machinery of a more efficient type, providing, of course, that those called upon to manipulate the machinery are fairly dealt by. I am quite sure that this is the case, notwithstanding what was said and done on both sides during the recent dispute. I will not deny that some members have on occasion behaved in a manner calculated to create a very wrong and unfavourable impression as to the attitude of the Union to changing methods of production. Also there are those in the ranks of the A.S.E. who would and do strive to narrow the scope and aim of the Union, *i.e.* they imitate their "superiors" in Statecraft and industry alike, and favour

A POLICY OF SECTIONALISM AND EXCLUSIVENESS

as against a growing cosmopolitanism, but these are a dwindling minority, and cannot in any material way influence the policy of the organisation.

The note of alarm that has been sounded consequent upon orders going from Britain to America for locomotives, whilst it shows the efficiency of the American locomotive builders, does not, even in the smallest degree, prove the decadence of British workmanship.

Whatever the Americans make a speciality of, they are likely to make the running hot for any competitor, and the opening of vast areas in the United States since the introduction of the locomotive, and which has only been possible by its use, compelled the Americans to specialise on the production of "locos." The large "loco" shops in the States are several times the size of the largest in this country, and on a class of work so systematised as that of "loco" building, it is not a great tax upon such large establishments to turn out a few extra; but the important point to be observed in all this is that it is not a case of the British "loco" builders being in idleness, the fact being that more locomotives are being built now in the British Isles than at any previous period; activity in engineering is abnormal, and the "loco" shops are working overtime and in some instances double shifts. All the same, I consider it a very good thing that so much discussion is taking place on this subject, as it is likely to result in great good by causing thought to be devoted to securing a still higher standard of national efficiency. Workmen will lose nothing by encouraging machinery, as it carries with it a set of conditions distinctly favourable to general betterment. Employers will lose nothing by a manly fraternisation with all and sundry who are able and willing to contribute to the general success.



The Building of a Great Railway.

The Great Central Extension to London.

(*Continued from page* 110.)

WE offer no apology for publishing a history of the Great Central Railway Extension to London, in spite of the fact that the press throughout the country, both from technical and popular standpoints, have largely, and in a more or less detailed manner, described this great undertaking. An industrial Magazine, with such pretensions to thoroughness in scope and treatment as are claimed for this publication, and whose appearance is practically contemporaneous with the completion and opening of the railway under consideration, would be falling short of its policy and programme in neglecting to record and describe the features in the history and construction of one of the greatest engineering achievements of the latter end of the century.

But our justification will not be merely on this account. We claim for this particular series of articles a completeness and authenticity both in respect of the line itself and of the machinery used in conjunction therewith, which will render it an altogether exceptional compilation. The Editors have received in the construction of the articles the unstinted services of all those prominently identified with the line, in particular

SIR DOUGLAS FOX, MR. EDWARD PARRY, M.I.C.E.,
SIR WILLIAM POLLITT, MR. J. ROSTERN, MR. HARRY POLLITT,

the Resident Engineers, and the several contractors.

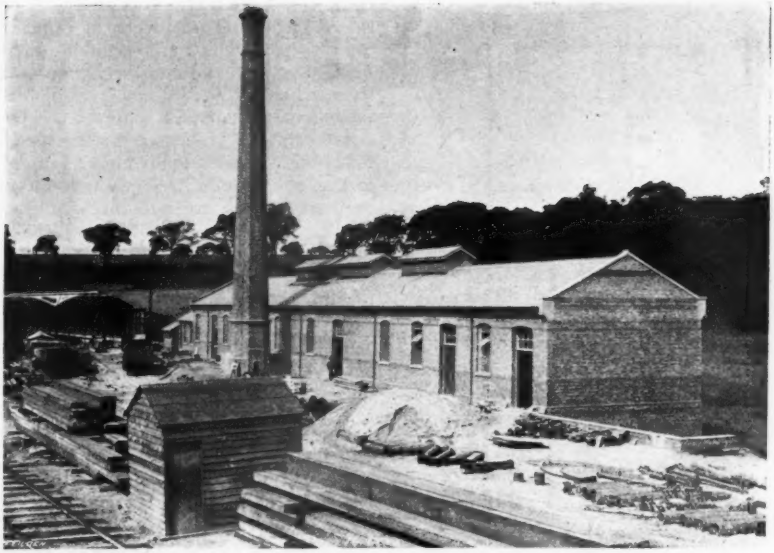
The sectionised articles will be run through six or seven issues, the initial instalment dealing with the first contract, commencing at Annesley, and so on, until the London terminus is reached.

Special machinery and plant will be noticed where possible at such points where it has been installed, and the series will be concluded with an article assigned to the locomotive and rolling stock departments, including a description of the signalling and running arrangements.

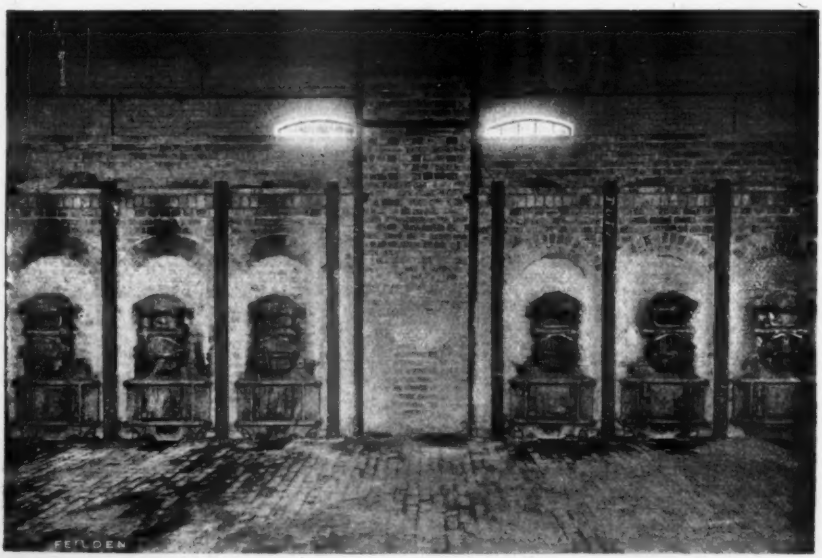
The whole will be lavishly illustrated from photographs and working drawings, and the descriptive matter so treated as to appeal to the practical engineer and lay reader alike.

THE Oil Gas Works at Basford is one of three almost identical works which were decided upon by the Great Central Railway for lighting the new carriage stock rendered necessary by their recent extension to London. Each of these works is designed to supply the necessary gas for about 500 coaches, the other two works being situated at Leicester and London respectively. The plans of all three works were prepared by Mr. T. Parker, Jun., the Carriage and Wagon Superintendent of the Great Central Line, and a contract for all three of the works was entrusted to the well-known Messrs. W. Pope & Son, Ltd., who have had an unequalled experience in this speciality.

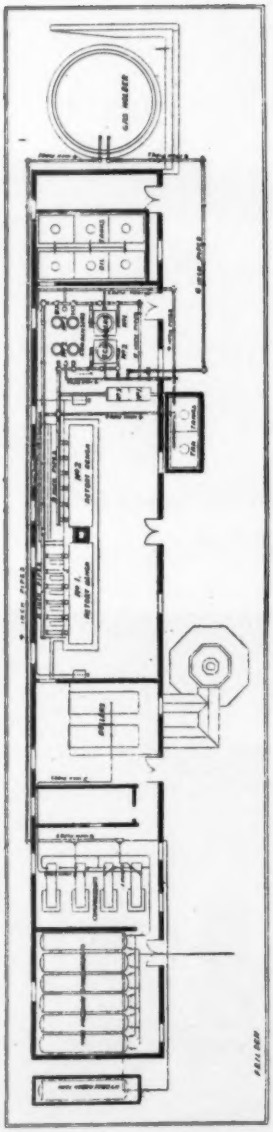
The works now in question, a general plan of which is given on page 218, comprise 12 pairs of 10-in. D shaped retorts, built up in two separate benches of 6 pairs each. Each of these benches can be worked independently of the other, and is provided with independent connections and a separate set of apparatus



OIL GAS WORKS, NEW BASFORD.



THE D SHAPED RETORTS, BASFORD GAS WORKS.



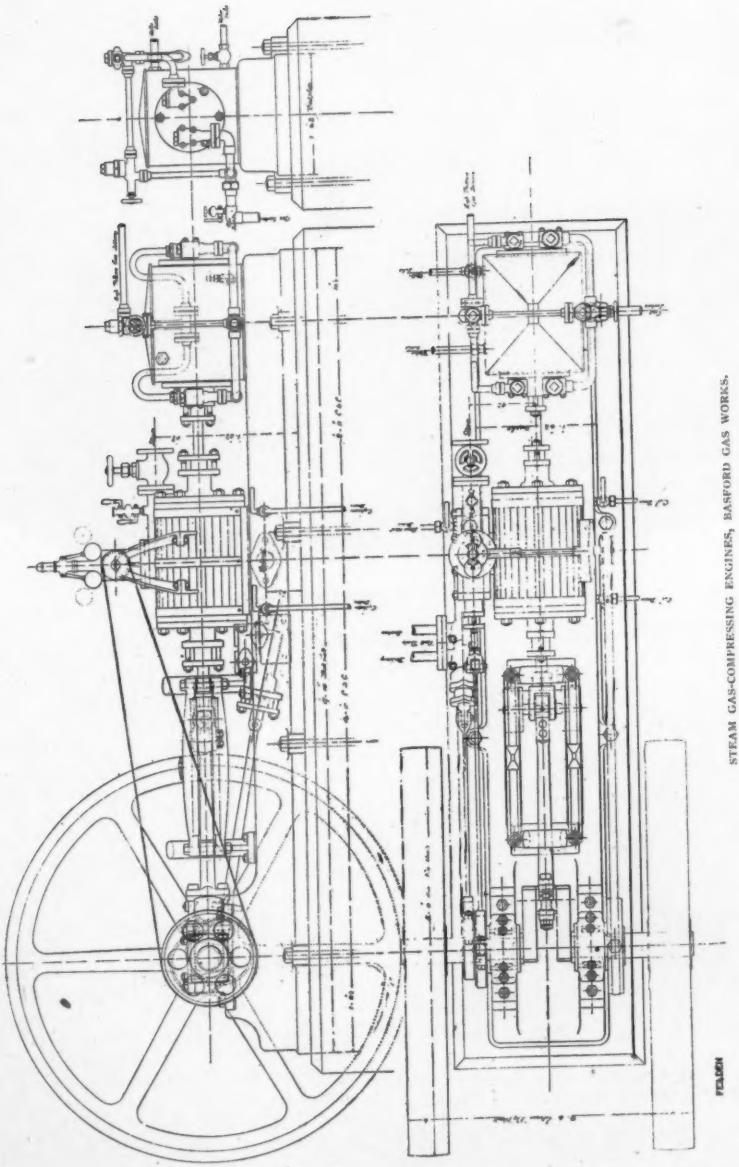
GENERAL PLAN OF BASFORD GAS WORKS.

complete, so that the works may be considered as being practically in duplicate, the only parts which are common to both being the gasometer and the high-pressure storage holders, which, not being liable to derangement, can with safety be kept in constant use. The make of each pair of these retorts is nominally about 350 cubic feet of gas per hour, and we may say that they are at the present moment giving about 420 feet per hour of gas of excellent quality.

Passing from the retorts, the course of the gas is first through four annular pattern condensers, two of these being in connection with each bench of retorts. Thence it passes through one of two tower scrubbers, built with boards on edge and provided with a water spray arrangement. From the scrubbers the gas passes through two meters in cast-iron cases to the gasometer, which is of 4,000 feet capacity, and measures 22 ft. 9 in. diameter by 10 ft. lift. This gasometer, an illustration of which will be found on page 220, supplies the source from which the compressing engines draw their gas, and the pressure to which it is adjusted is equal to about $\frac{1}{2}$ in. head of water.

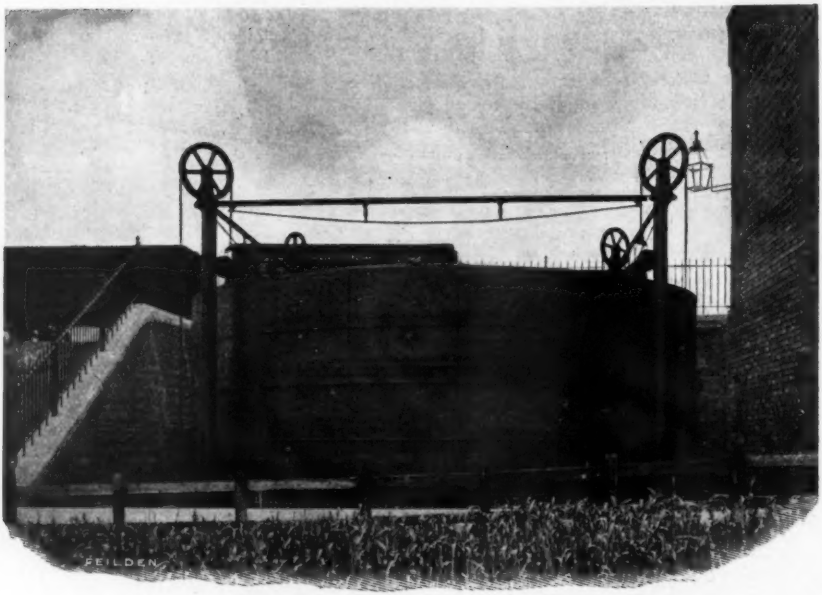
The steam gas-compressing engines are shown in section in the diagram on page 219. The cylinders are 9 in. and 6 in. diameter by 14 in. stroke, and each engine, at a pressure of 60 lbs. steam, is capable of compressing 1,300 cubic feet of gas per hour to 150 lbs. per square inch. The engines, as well as the rest of the plant, are arranged of such a number that one half can always be kept in reserve when one bench of retorts is working up to its full capacity.

The boilers for supplying steam to these engines are of the Cornish type and two in number, 5 ft. diameter, 16 ft. long, with flue 2 ft. 9. in. diameter, fitted each with two Galloway tubes; all the mountings are flanged out of mild steel, and the feed is provided with two of Messrs. Pope's special re-starting injectors, as well as with feed pumps, of which one is provided on each engine. From the engines the gas is delivered into 12 mild-steel high-pressure gas storage holders, each one measuring 4 ft. 3 in. diameter by 20 ft. long, with



STEAM GAS-COMPRESSING ENGINES, BASFORD GAS WORKS.

FELDEN



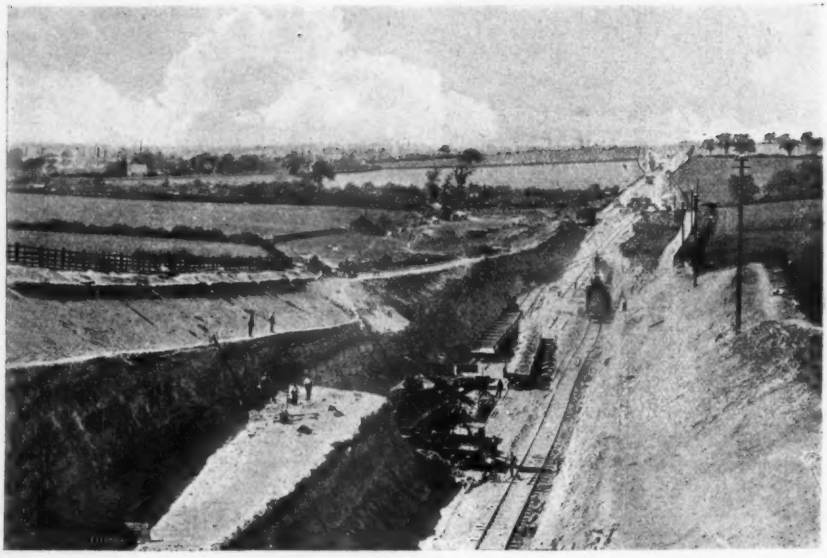
GASOMETER, BASFORD GAS WORKS.

dished and flanged ends. The shell plates are $\frac{7}{16}$ in. thick, and the ends $\frac{1}{2}$ in. thick,

MR. A. H. COLLINSON, M.I.C.E.,
Resident Engineer of Section "A," No. 1 Contract.

the test pressure being 250 lbs. hydraulic. A further similar holder is provided for collecting the condensed hydro-carbon liquid which is thrown down from the gas during the process of compression.

A short distance beyond this point the line passes under Sherwood Rise, a high-lying district at the north end of Nottingham, in tunnel, opening out upon Carrington Station. Sherwood Rise Tunnel passes for a distance of 668 yards underground through Bunter sandstone, and is of somewhat peculiar construction to meet the difficulties encountered in rock and soil. The solid rock supplies the place of the side walls, usually of brick or concrete, and in these rocky walls two manholes of different sizes are excavated. The larger of these two is 10 ft. wide by 10 ft. deep by 9 ft. 6 ins. high at the crown of the arch. This is used as a tool-house, while the other, of much smaller dimensions, is a recess to allow the men to get out of the way of a passing train. The lining is of brickwork 1 ft. 6 ins. in thickness, and the filling of lime concrete made of three parts gravel or broken stone and two of

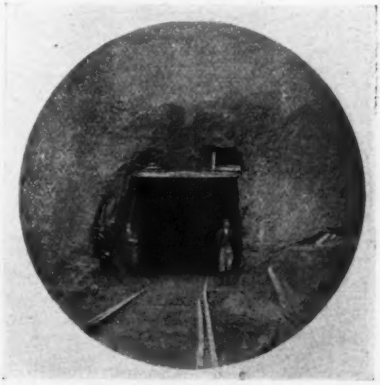


SHERWOOD RISE CUTTING IN JUNE, 1895.

sand to one part of lime, that is as five to one. The drain pipes of earthenware, one foot in diameter, are laid under the formation in the six-foot way.

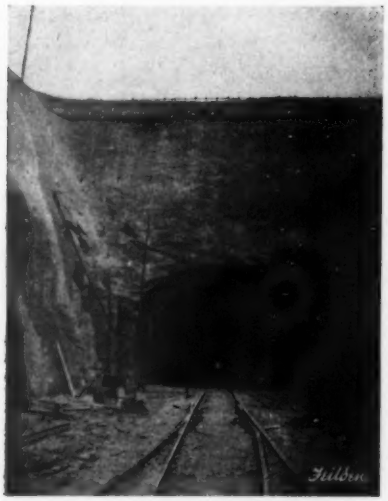
Carrington Station, the fourth and last to the north of Nottingham, is a ticket station, and will be of great convenience to the large population at the northern end of the city. It immediately precedes the tunnel under Mansfield Road, which is 1,200 yards in length. The excavating operations under Nottingham revealed many relics and laid bare portions of the old town wall. Many difficulties attended this work, which was at the same time of a very expensive nature, involving the construction of heavy retaining walls between the tunnels.

Contract No. 1 is divided into two districts. The first or "A" district, which terminates at this point, is under the charge of Mr. A. H. Collinson, M.I.C.E., one of Mr. Parry's able assistants, and who has held the position from March, 1898, to the completion of the line. His recent election to the membership of the Institution of Civil Engineers was due mainly to his connection with this important section of the line. His predecessor was Mr. H. E. Allen, A.M.I.C.E.



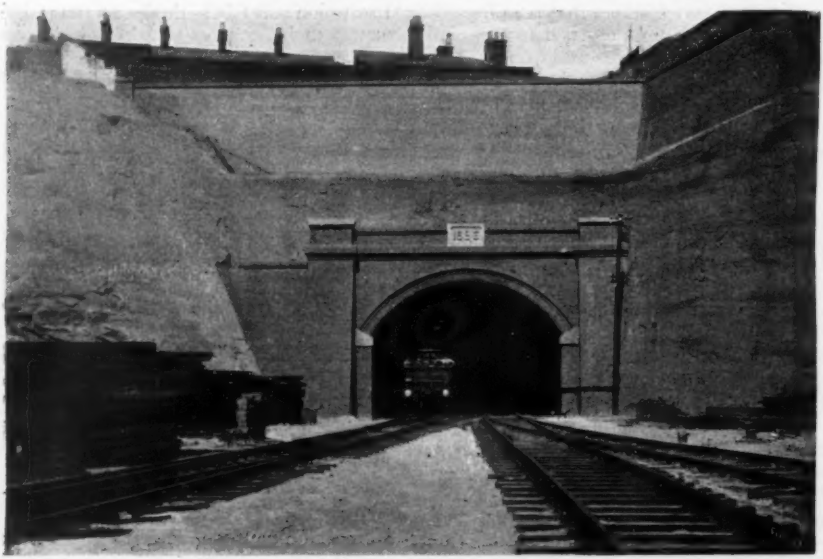
SOUTH FACE AND HEADING OF SHERWOOD RISE TUNNEL.

From the tunnel under Mansfield Road



SHERWOOD RISE TUNNEL, NORTH END, SHOWING CARRINGTON OPEN CUTTING.

the line emerges into daylight at the north end of the Central station. This station, as before remarked, is the joint property of the Great Central and Great Northern Companies, and on its completion will be one of the most important and commodious stations in the Midlands. About 600,000 cubic yards of excavation, principally in sandstone rock, were removed in clearing the site, and this exceptional work was carried through in the remarkably short period of eight months. The work was rendered unusually difficult by the fact that the excavation had to be commenced from the mouth of the tunnel at both the north and south ends of the station site, and conveyed through them to the tips. The station, which is now nearing completion, and a plan of which is given on page 225, will occupy an area of about twelve acres, right in the centre of the city. The ground was formerly covered for the greater part by a very dense population, occupying generally very insanitary dwellings. The north end occupies the site of the old Nottingham workhouse, which had to be acquired and demolished. The station itself will consist of two large island platforms, each about



MANSFIELD ROAD TUNNEL, NOTTINGHAM.

1,300 feet long and 68 feet broad, with two bays at each end for local traffic. The central span is 84 feet wide, adjoining which are two small annexes of 18 feet wide each, which in turn are connected with two outer spans of 63 feet in width. The main roof is 425 feet long. General waiting rooms and refreshment rooms are placed upon each platform, while the booking and parcels offices, &c., are situated in the Mansfield Road, immediately opposite the east end of Shakespeare Street.

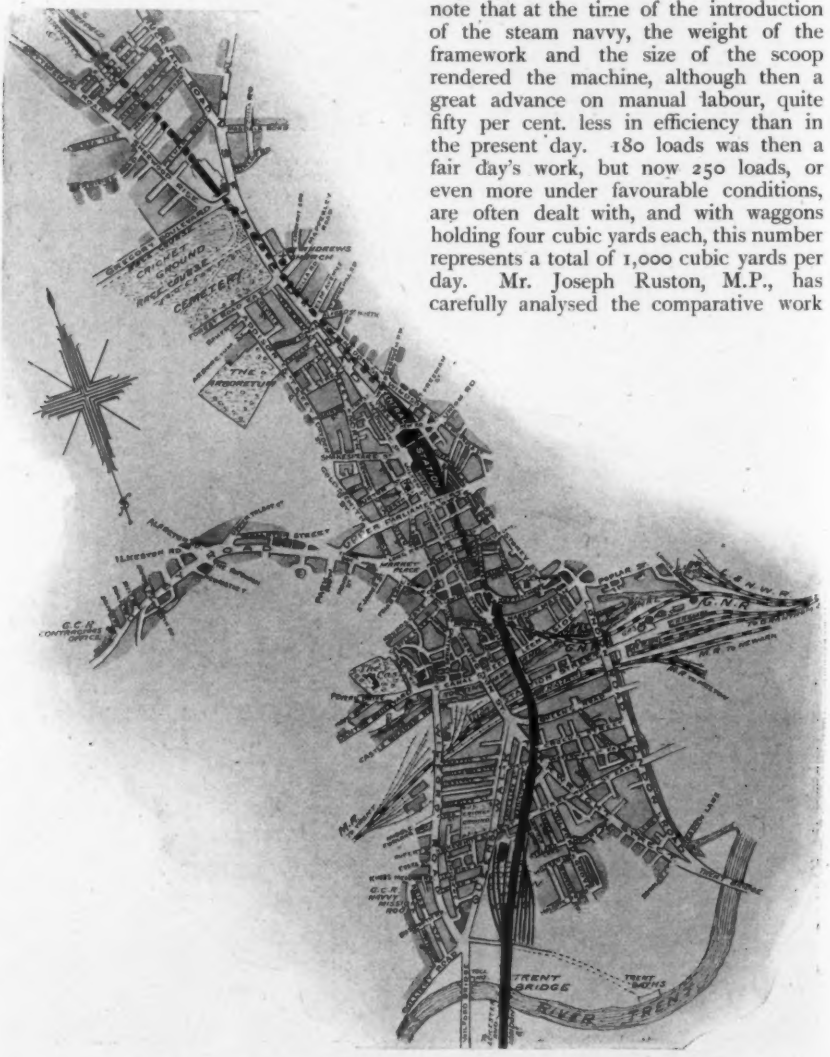
South of the station the line passes under Thurland Street and Victoria Street, and for a considerable distance under important private property, consisting of shops, warehouses, offices, etc., which had to be acquired, and under which a tunnel has been constructed. The Victoria Street tunnel, 400 yards long, entailed some very costly and difficult engineering work owing to the levels at which the line runs, the crown of the tunnel being in some cases above, and in others only a short distance underneath the cellar floors, necessitating the buildings overhead being carefully supported by underpinning while the tunnelling operations were being carried forward. Immediately south of this tunnel, from which the line emerges at Weekday Cross, is another

LOOKING NORTH FROM MANSFIELD ROAD TUNNEL, SHOWING SHERWOOD RISE TUNNEL AND CARRINGTON OPEN CUTTING.

TIMBERING FOR RETAINING WALL, LINCOLN STREET, NOTTINGHAM.

junction of the Great Northern Company, by which their trains from the south will have access to the central station.

Concerning the extensive excavating operations entailed, some mention of the steam navvies employed is called for. Those employed throughout the line were of the latest type, most of which were supplied by Messrs. Ruston, Proctor & Co. of Lincoln. It will interest the majority of the readers of this article to note that at the time of the introduction of the steam navvy, the weight of the framework and the size of the scoop rendered the machine, although then a great advance on manual labour, quite fifty per cent. less in efficiency than in the present day. 180 loads was then a fair day's work, but now 250 loads, or even more under favourable conditions, are often dealt with, and with waggons holding four cubic yards each, this number represents a total of 1,000 cubic yards per day. Mr. Joseph Ruston, M.P., has carefully analysed the comparative work



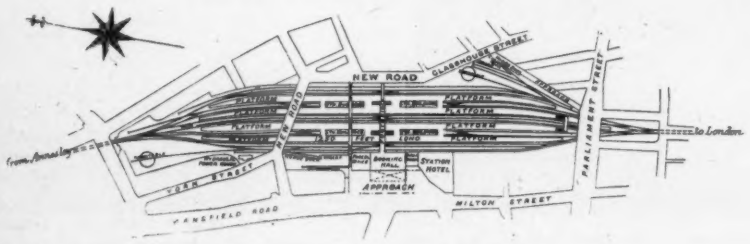
MAP OF THE ROUTE OF THE GREAT CENTRAL RAILWAY THROUGH THE TOWN OF NOTTINGHAM.

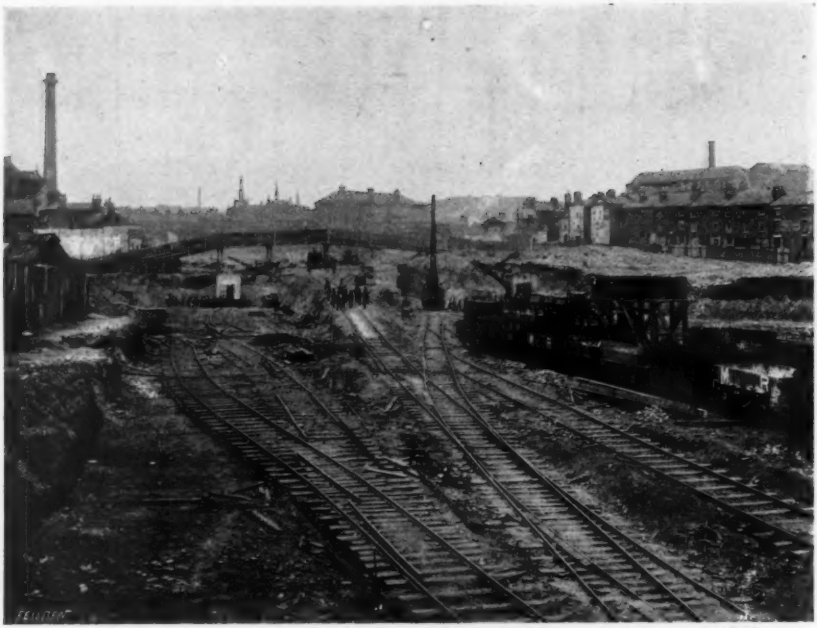
STEAM NAVVY USED FOR EXCAVATIONS. MAKERS, MESSRS. RUSTON, PROCTOR AND CO., LTD., LINCOLN.

which the navvy made by his firm can perform, and we may judge that a very large saving is the result. Independently of its easier employment upon work where a labourer would be at great disadvantage, about 2*d.* to 6*d.* per cubic yard may be safely reckoned upon, and the harder the stuff, the greater is this economy over hand work. It is somewhat difficult to exactly estimate the saving in cost, as in different districts with heavy earth the estimate for excavation must vary greatly. The cost for stiff brown clay has been given as 10¾*d.* per yard, while a stiff hard tough clay containing boulders was estimated at 1*s.* 6*d.* per cubic yard by the hand, as against 4¾*d.* by the machine. The steam navvy may be considered equal to at least sixty or seventy men. We illustrate in the photograph given above the latest type of navvy, such as was in general use throughout the line.

Leaving Weekday Cross the line passes over a viaduct of 1,000 yards in length,

G.C.R. Nottingham Passenger Station.





SITE OF CENTRAL STATION, NOTTINGHAM.

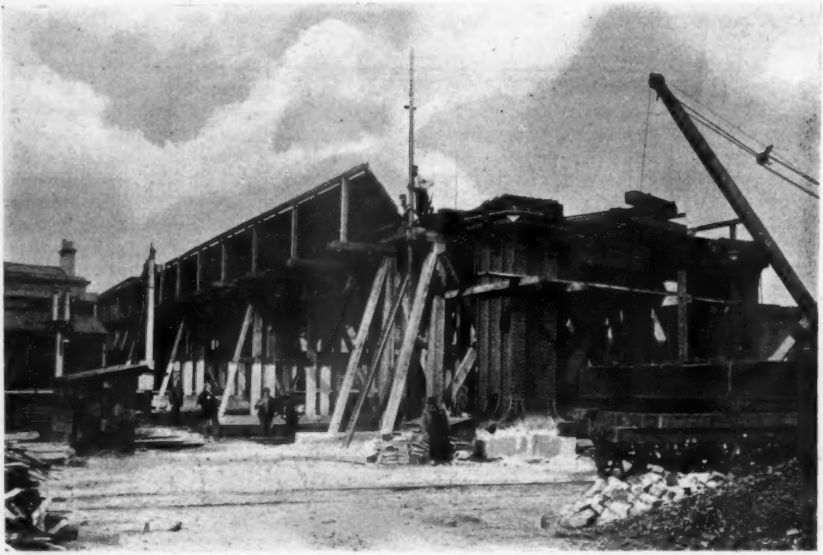
crossing in its course a number of streets, a canal, and most important of all, the west

CROWN LINING THURLAND STREET TUNNEL, NORTH END, IN 1897.

end of the Nottingham Passenger Station of the Midland Company, which by Parliamentary arrangement with that Company is spanned by a large bridge, the main passenger lines and platforms being crossed by a single span of 170 feet, a somewhat lesser span passing over the goods lines and sidings.

This bridge constitutes one of the most important pieces of work on the northern section, and we reproduce some of the more important portions from the working drawings.

The bridge is of the steel open-work girder pattern, and crosses the Midland Railway at a skew angle of 77 deg. 53 min. There are three spans of 50 ft., 170 ft., and 104 ft. respectively. The main girders are all of the lattice type, as will be seen by the accompanying illustrations; those of the centre span being hog-backed, the top flange having a curve of 565 ft. radius. The depth of the girders at the ends is 13 ft., and at the centre 19 ft. 17 ins., the total length comprising 172 ft. 6 ins. Fig. 1 shows the details of a portion of one of the centre span



STAGING FOR CENTRE SPAN OF BRIDGE OVER THE MIDLAND RAILWAY, NOTTINGHAM.

MIDLAND BRIDGE, NOTTINGHAM (WEST).

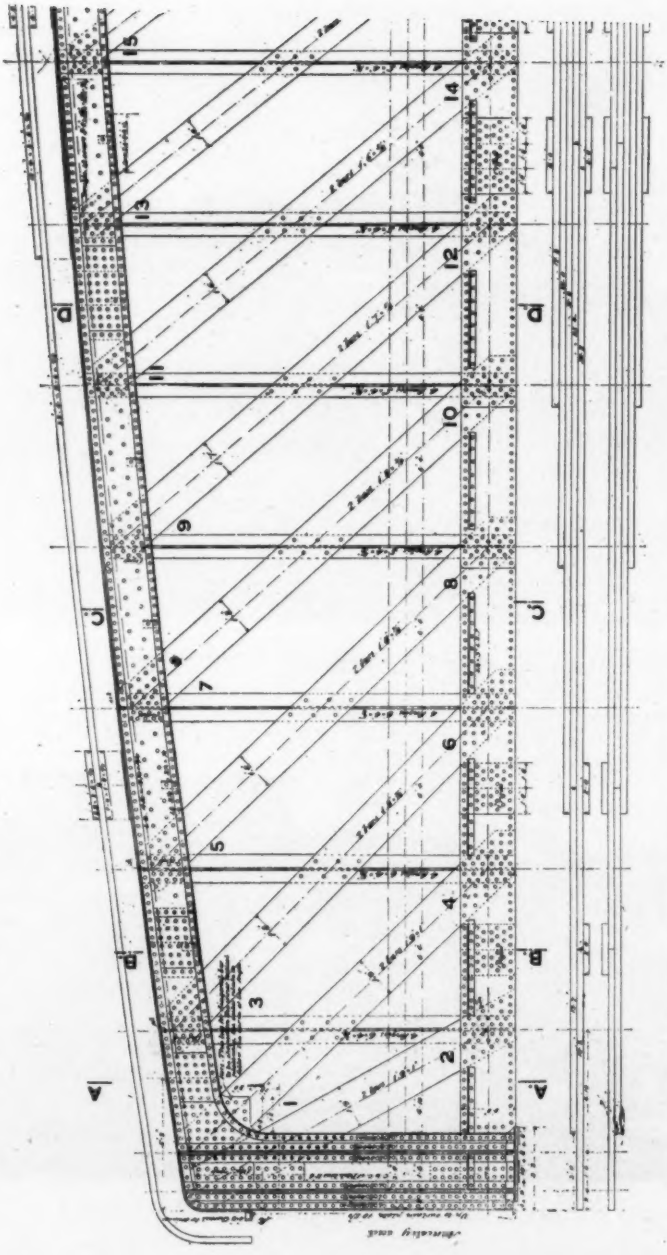


FIG. 1.—BRIDGE OVER THE MIDLAND RAILWAY AT NOTTINGHAM. DETAILS OF STEELWORK FOR 171 FT. MAIN GIRDER. INSIDE ELEVATION OF PART OF GIRDER.

girders, together with the development of the top and bottom boom plates. Fig. 2 is a cross section of the centre span, showing the general construction of cross girders and flooring, together with the overhead bracing. This illustration also shows the different forms adopted in the construction of the upper and lower booms. The former are of the inverted trough shape, consisting of two horizontal steel plates 3 ft. 6 ins. wide by $\frac{5}{8}$ in. thick, which are connected to a pair of vertical plates, 2 ins. by $\frac{3}{4}$ in., by means of four angle steels $4\frac{1}{2}$ ft. by $4\frac{1}{2}$ ft. by $\frac{3}{4}$ ft. The vertical plates at the other end are held together by two angle steels $3\frac{1}{2}$ ft. by $3\frac{1}{2}$ ft. by $\frac{1}{2}$ ft., and the whole boom strengthened at regular intervals by intermediate solid diaphragm plates.

In the lower flange of the main girder, to overcome the objections attaching to the trough principle, whereby in the lower position it would become a receptacle for water, dirt, &c., the horizontal plates are dispensed with, the twelve vertical plates, 2 ft. 2 ins. in depth, only being used, arranged six on each side and being rivetted to the open web.

Vertical struts and diagonal ties connect the upper and lower booms. The upper booms of the main girders are connected at intervals of 19 ft. by five overhead trussed bracing arches, details of which are shown in Figs. 2 and 5.

Fig. 5 shows the general plan of the centre span and indicates the angle at which the bridge has been built. At JJ. are cross girders 30 ft. 3 in. long, 2 ft. 3 in. deep at the centre, and 1 ft. 4 in. at their junction with the main girders.

Fig. 3 gives the details of the girder bearings for the south end of the station street span, and the north end of the centre or main span.

The main girders of the bridge rest upon two cylindrical piers of 12 ft. diameter; the main portion, that is, from 2 ft. above the rail level of the Midland Railway to the under surface of the bed-plates, being built up entirely of steel. Fig. 4 shows all the

MIDLAND BRIDGE, NOTTINGHAM: VIEW OF MAIN GIRDERS LOOKING NORTH, AND SHOWING OVERHEAD BRACING.

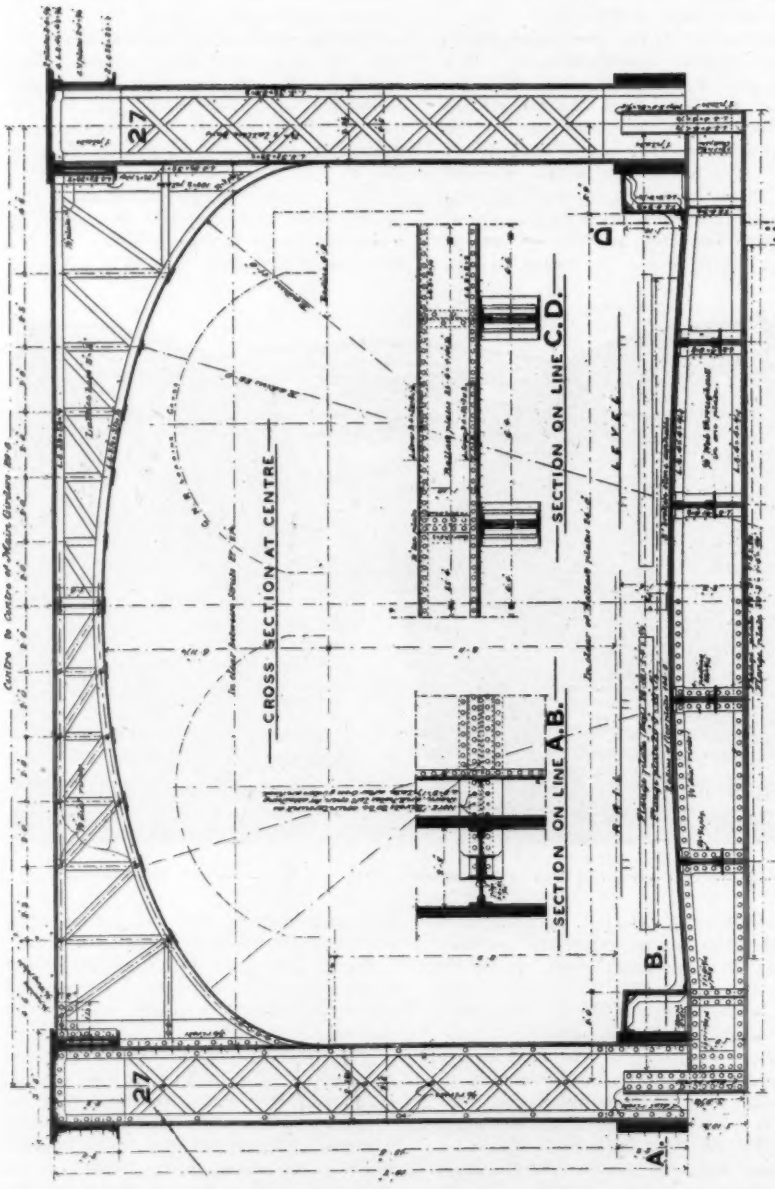


FIG. 2.—BRIDGE OVER THE MIDLAND RAILWAY AT NOTTINGHAM. DETAILS OF FLOORING, OVERHEAD BRACING, ETC., FOR 171 FT. OPENING.

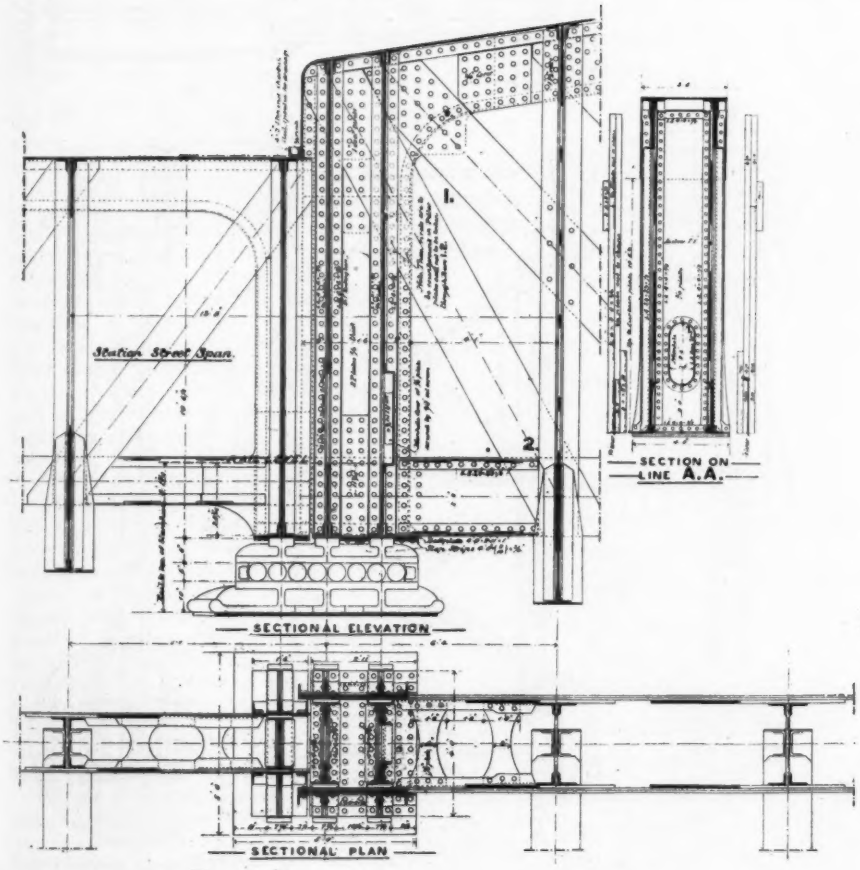


FIG. 3.—BRIDGE OVER THE MIDLAND RAILWAY, NOTTINGHAM: DETAILS OF NORTH END PILLAR ON PIER NO. 1.

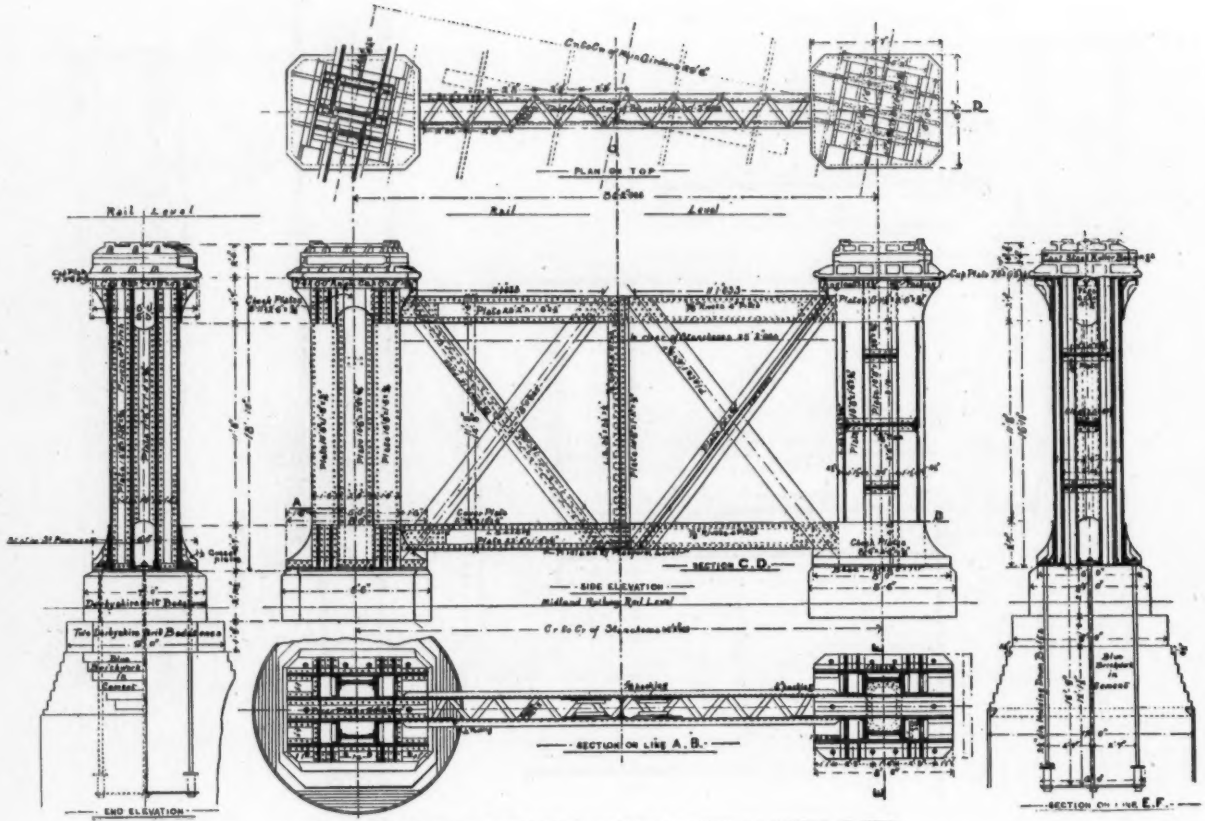


FIG. 4.—BRIDGE OVER THE MIDLAND RAILWAY AT NOTTINGHAM: DETAILS OF PIERS.

details of the piers in half elevation and section.

The connections consist of an upper transverse frame which is made up of two webs, 23 ft. long by 1 ft. 6 in. deep by ½-in. thick, and four angle steels, 4 in. by 4 in. by ½-in. joining the top of the steel columns, and a cross truss of similar construction joining the lower ends.

Vertical and diagonal struts brace these together, as shown in Fig. 4, together with details of the upper transome, top of pier, and lower transome.

The piers rest upon foundation cylinders of cast-iron 12 ft. in diameter, filled with blue brickwork, in cement which has been taken down to the solid rock, the operation being performed under air-pressure. The total weight of steel used in this structure amounts to 918 tons, in addition to 130 tons of cast-iron. Our illustrations, other than those showing the constructional details, consist of views of the main girders and overhead bracing, staging for centre span, and a general view of the completed structure.

A little farther south occurs the Arkwright Street Station of the Company, the ticket collecting depôt of the southern end of the city. It is on a high level and approached from Arkwright Street by means of steps. As it is the nearest station to the Trent Bridge Cricket and Football Grounds, there will undoubtedly be a very large passenger traffic to and from this point. Pending the completion of the Central Station, the traffic is distributed between Arkwright Street Station on the south, and Carrington Station at the north side of the town.

Passing southwards a short distance, the passenger lines cross another large area, purchased from the Corporation, amounting to about 33 acres, which has been laid out on the west side as a goods yard with the usual goods offices, sidings, etc., and on the east side as a locomotive yard with a locomotive shed, carriage shed, and sidings connected therewith; there being also sidings and cattle docks on this side of the line. A general plan of this yard is illustrated on page 234. This yard is lighted by electricity, a large building in connection with the electric

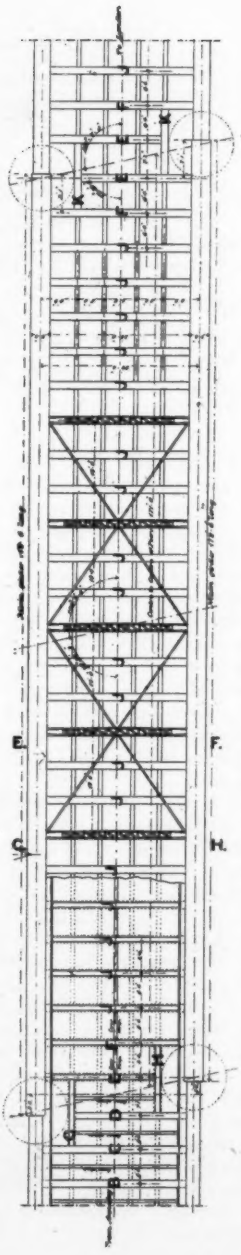
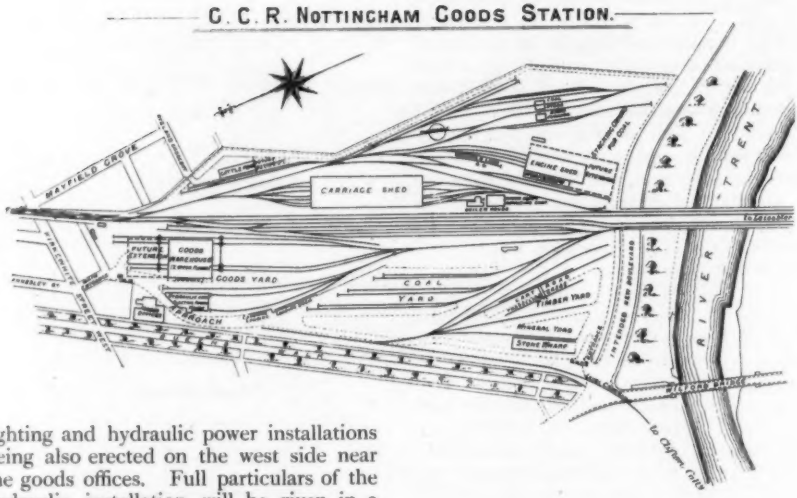


FIG. 5.—BRIDGE OVER THE MIDLAND RAILWAY NOTTINGHAM: GENERAL PLAN.

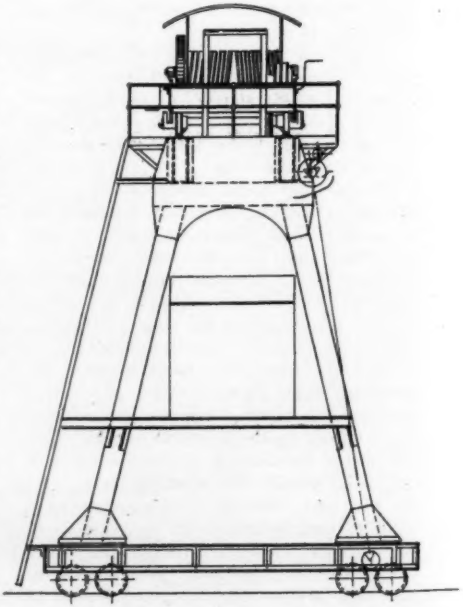
G. C. R. NOTTINGHAM GOODS STATION.



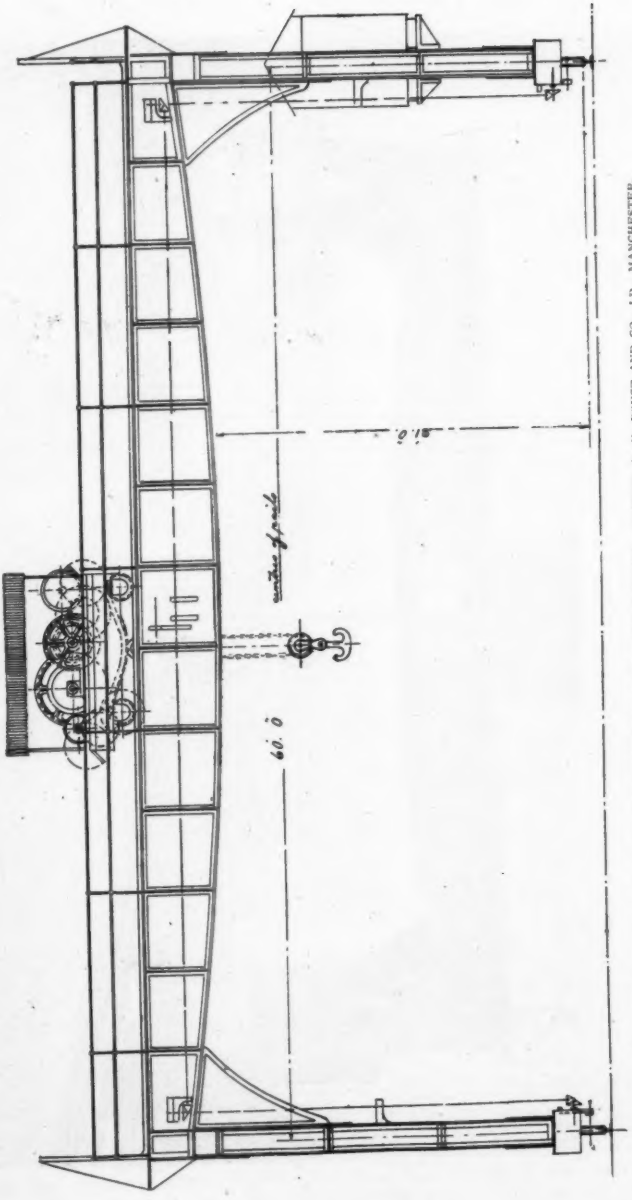
lighting and hydraulic power installations being also erected on the west side near the goods offices. Full particulars of the hydraulic installation will be given in a later instalment of this article. Here, as at Leicester and London, an electrically driven goliath crane has been erected.

These machines are, we believe, the first of their kind constructed. It is not too much to designate them as triumphs of mechanical skill. Our illustrations show side and end elevations, and photos of the crane at the Marylebone terminus, which is similar in all respects to the other two put down.

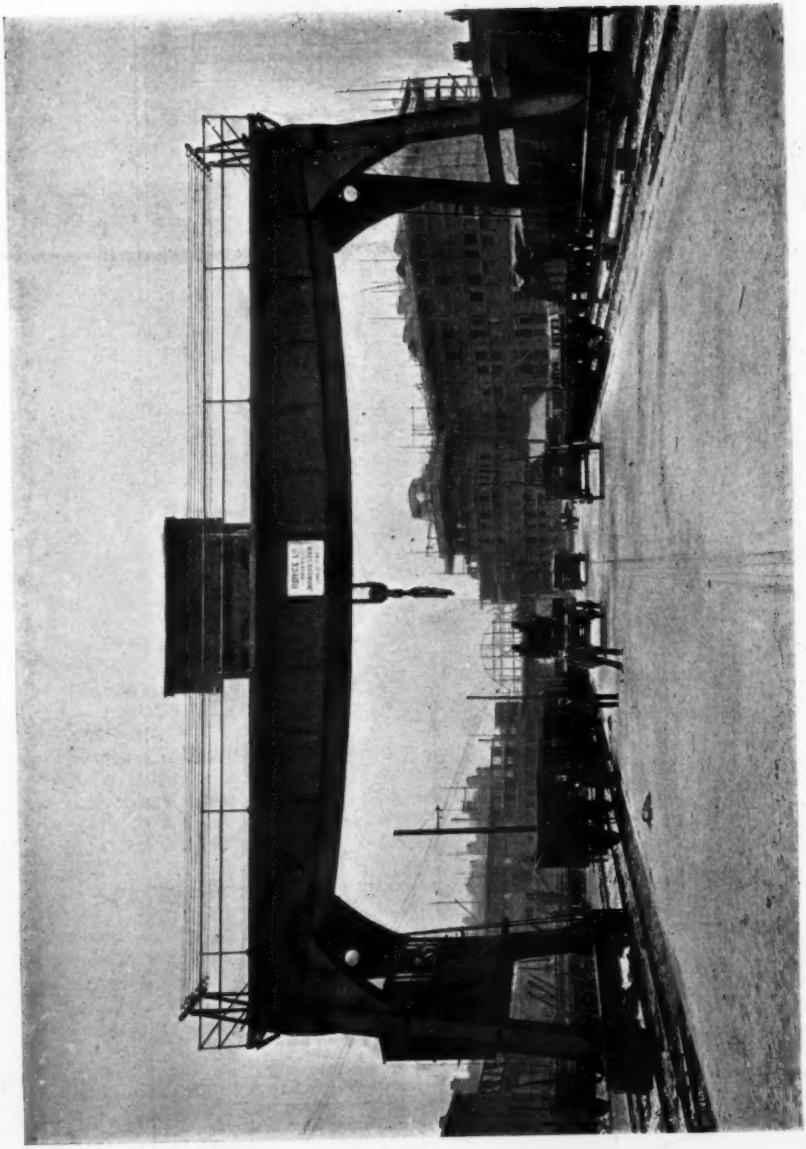
Over 60 ft. span, with head-room underneath the girders of 21 ft., the full load of 25 tons can be lifted at a speed of 5 ft. per minute. Lighter loads can be moved in an inverse ratio, a load of 5 tons being raised at 25 ft. per minute. The traversing and travelling speed are 50 ft. a minute. The construction offers many points of interest. The box girders of mild steel 4 ft. 6 ins. deep in the centre by 16 ins. wide, form the framework on which the stability of the structure depends, and special care is taken that the weight of the crane is evenly distributed over the eight longitudinal travelling wheels by the use of compensating levers, pivoted under the centre of each of the four uprights. This we consider a decided improvement and a distinct advance.



END ELEVATION OF 25-TON ELECTRICALLY-DRIVEN GOLIATH CRANE.
MAKERS, MESSRS. F. H. ROYCE AND CO., LD., MANCHESTER.

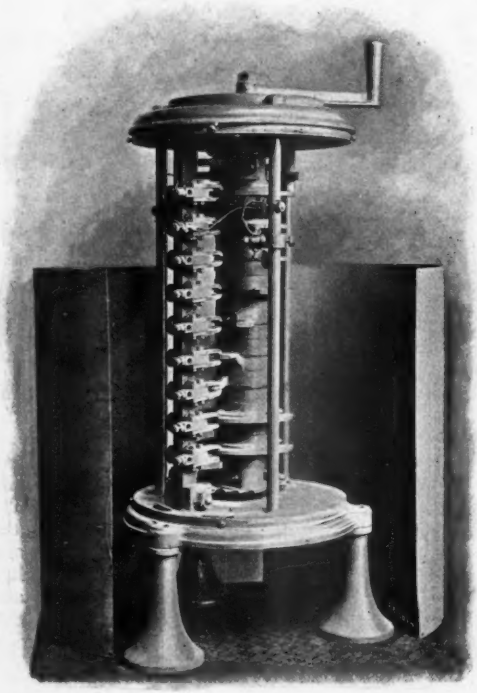


SIDE ELEVATION OF 35-TON ELECTRICALLY-DRIVEN GOLIATH CRANE. MAKERS, F. H. ROYCE AND CO., LD., MANCHESTER.



25-TON ELECTRICALLY-DRIVEN GOLIATH CRANE AT THE MARYLEBONE GOODS STATION OF THE GREAT CENTRAL RAILWAY CO.
MAKERS, F. H. ROYCE AND CO., LD., MANCHESTER.

Roller bearings have been used for all travelling and traversing axles ; this greatly reduces the starting and running power required for these motions, which not only decreases the strain upon the gearing but adds considerably to the efficiency of the crane, and consequently decreases the cost of working. This is one of the points where we believe Messrs. Royce & Co. are distinctly in advance of the usual practice.



CONTROLLER USED ON ELECTRICALLY-DRIVEN CRANES.

All the heavily-strained gearing and wheels are made of cast steel.

All bearings are arranged to swivel on their centres, thus ensuring the even distribution of the load over the entire length of the wearing surface, which, besides greatly adding to the life of the bearings, considerably reduces the friction.

The crab side frames are constructed of stout steel plates, stiffened by strong angles. All shafts and axles are so arranged that they can be lifted out directly, in this way avoiding the inconvenient and troublesome method of threading shafts so often adopted by crane builders.

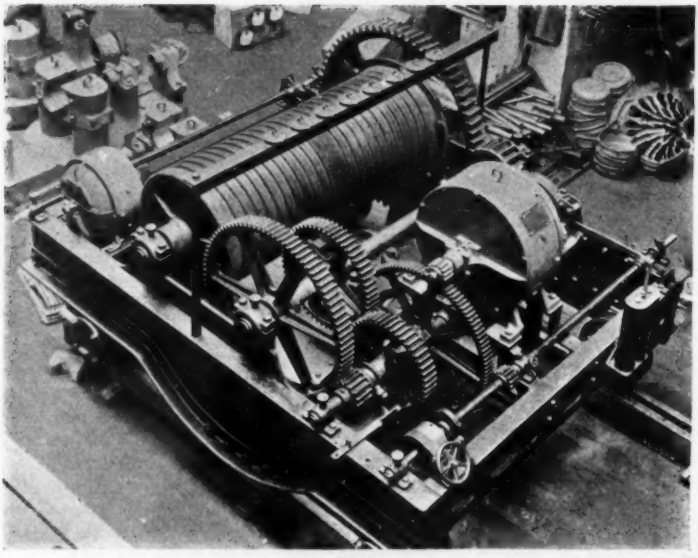
The electro-motors are of the well-known "Royce" make, of their completely enclosed slow speed multipolar type, and seem exceedingly well adapted for this purpose.

The hook is double, to facilitate the slinging of large loads, and an additional small single hook is provided for loads of five tons and less. The main hook swivels freely even with exceedingly heavy loads, owing to the use of conical rollers of hard steel running in correctly shaped paths.

The motor for the longitudinal travelling motion is fixed upon supporting brackets attached to the centre of one of the main girders, in order to equally distribute the propelling forces and prevent any possibility of cross winding upon the rails. The cross traversing and hoisting motors are mounted upon the crab.

The whole of the motions are controlled from the cabin shown in the illustration, where the necessary switch, &c., are fixed.

Another excellent provision which shows the forethought exercised in designing these powerful machines is that of an automatic magnetic brake, again of a "Royce" patent type, which is combined with the hoisting motor. The act of switching off, or the interruption from any cause of the supply of current, without any attention on the part of the operator, automatically releases the brake and allows it to take charge of and sustain the load in whatever position it may happen to be



CRAB FOR 25-TON ELECTRICALLY-DRIVEN GOLIATH CRANE.

at the time. This brake is constructed of exceedingly powerful solenoids, acting upon a linked band of metal, which is extremely flexible and provides a very large wearing surface.

In spite of the dimensions and the enormous weight of the crane, which is with load about 75 tons, simplicity combined with strength and solidity are the characteristics—a monster machine which moves both itself and heavy masses with ease and safety. We need not add that materials and workmanship are of the highest class, and in the design, which is such as to fully and efficiently utilise both the electrical and mechanical power, Messrs. Royce & Co., of Manchester, the town highly interested in the Great Central Railway, have been singularly successful.

Almost immediately south of the Nottingham Goods yard, the longest and most important bridge on the whole line is met, crossing the River Trent and providing for four sets of rails, a full description of which will open the article in our next issue.

(To be continued.)

MACHINERY, APPLIANCES AND PROCESSES.

"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

NEW STEAM MOTOR-DRIVEN LORRY.

THE steam lorry is one of the natural developments of the introduction of the motor vehicle, and, although it has only recently been able to demonstrate its practical utility, there are already a number of types of this locomotive contrivance in the market. Whatever may be the modifications which may be forthcoming, the general principle of the steam motor-driven lorry is accepted and has evidently come to stay.

The particular type of steam lorry which we illustrate is one which has been introduced by Messrs. T. Coulthard & Co., of Cooper Road, Preston. This vehicle has been built with a view to taking a load of three tons up a gradient of 14 in 10. It is provided with steam boilers of the liquid fuel class, for which any common sort of petroleum is suitable. As will be seen from the illustration the engine, boiler, gearing, and the whole of the apparatus for manipulating the vehicle are enclosed in a cab arranged in the front. The platform, which is carried on a steel frame, is 10 ft. 6 in. long by 5 ft. 8 in. wide. The engine is of the maker's patent triple-expansion type, and, as far as we are aware, Messrs. T. Coulthard & Co. are the first to use this type of engine for self-propelled vehicles. In any case we believe they are

NEW STEAM MOTOR-DRIVEN LORRY BY MESSRS. T. COULTHARD AND CO., PRESTON.

the first firm to construct a triple-expansion engine having only two main bearings. The object of using a triple expansion engine in such a combination is, of course, to obtain a considerably greater power from a given amount of steam. This is obtained with little or no more application than the usual ordinary compound type.

Further reference to the illustration will indicate that a number of indented tubes are arranged in the front of the vehicle. The exhaust is taken from the low pressure cylinder through the feed-water heater, and then through the indented tubes, the condensed steam then returning to the water tank. By means of this system the lorry is enabled to run for a considerable distance on a very small quantity of water. The fuel supply to the burner is automatic.

Three speeds are provided for the vehicle, namely, three, six and eight miles per hour going forward, and one of two-and-a-half miles backward. A band brake is placed in connection with the second motion shaft, which is actuated by a foot lever, and also two powerful brakes on the driving wheels, which are operated by means of worm and wheel. An additional brake effect is available by reversing the direction of the engine's rotation.

Altogether this steam lorry presents some excellent features, and is a useful contribution to the solution of the difficulties of heavy steam tractions on roads for produce waggons and allied vehicles. The general appearance of the combination is more symmetrical and comely than those of some other vehicles of the same kind which have come under our notice, and it will no doubt attract the attention of those to whom the employment of some such means of transport is becoming a matter of pressing importance.

SUBSCRIBERS to "FEILDEN'S MAGAZINE" are reminded that the Editor will be pleased to hear from them with advance particulars of any new machinery or specialities they may be bringing out or interested in. Nothing mediocre, stale, or commonplace will, however, find room in these columns.

NEW TYPE OF STAMP BATTERY FOR ORE CRUSHING.

AMONGST the many systems of ore reduction now employed in connection with mining operations, crushing by means of the stamp battery maintains its supremacy in the estimation of at least perhaps the majority of mining engineers. This fact, no doubt, accounts for the appearance every now and again of a new type of stamp, or at all events of modifications in matters of structural detail upon conventional designs. It is in the latter connection that the five-stamp battery, which is illustrated herewith, seems to demand notice. It has been erected at the works of Messrs. Bretts, Limited, at

NEW TYPE OF STAMP BATTERY.

Coventry, for the purpose principally of experiment and demonstration. It embodies in its construction the essential elements of Bretts' system of stamping press, as applied to the production of drop forgings.

Speaking first of this form of stamping press, it may be said that a typical example takes the shape of an entirely self-contained press, having complete independence from any considerations of supplementary shafting and gearing. The motive power may be steam or compressed air, and in either case the motive agent employed is admitted to the cylinder, which is fixed on a frame at the head of the press, and is provided with a rotary piston. This frame and cylinder, again, are independent of the hammer bed, and are thus not subjected to the results of the vibration which is necessarily consequent upon stamping operations. Then the axis of the rotary piston has a lifting fork, which is secured to the end of the flexible band, which passes over a pulley and raises the tup. The valve is provided with an arrangement by means of which the stroke can be regulated to meet the work under operation, while a hammer weighing several tons is just as readily controlled as one weighing as many hundredweights. The arrangements as a whole are very simple, a supply pipe for the steam or compressed air being the efficient substitute for the ordinarily more or less complex power transmission mechanisms commonly used.

It is the principle involved in the design and construction of this stamping press that has been adapted to the requirements of ore-crushing in the battery illustrated, and the embodiment has been skilfully contrived, with the result that, theoretically at all events, a capable piece of mining machinery has been produced, while, we understand, satisfactory working and crushing effects have been given in experimental practice.

In the case of the five-head battery illustrated, each stamp weighs 1,600 lbs., and is capable of working at a speed of 100 blows per minute with a 10-inch drop. At this speed a 6½ ton crushing result would be secured in 24 hours, the crushed material being reduced to a degree of fineness which the makers claim to be represented by a mesh of 900 holes to the square inch. If results like this can be secured and maintained in actual practice at a mine without any undue wear and tear, the machine would speedily establish for itself a reputation in the mining world. It is well to note that the transmission of shock and vibration, while the battery is working, from the base to the end of the machine, is obviated by the provision of a flexible connection between the wooden stem of the stamp and the lifting fork on the rotating axes of the cylinder. While one must necessarily await actual stamping results in ordinary practice before pronouncing finally regarding the possibilities of the new battery, the mechanical principles involved in the working arrangements should be quite capable of giving a good account of themselves in continuous work.

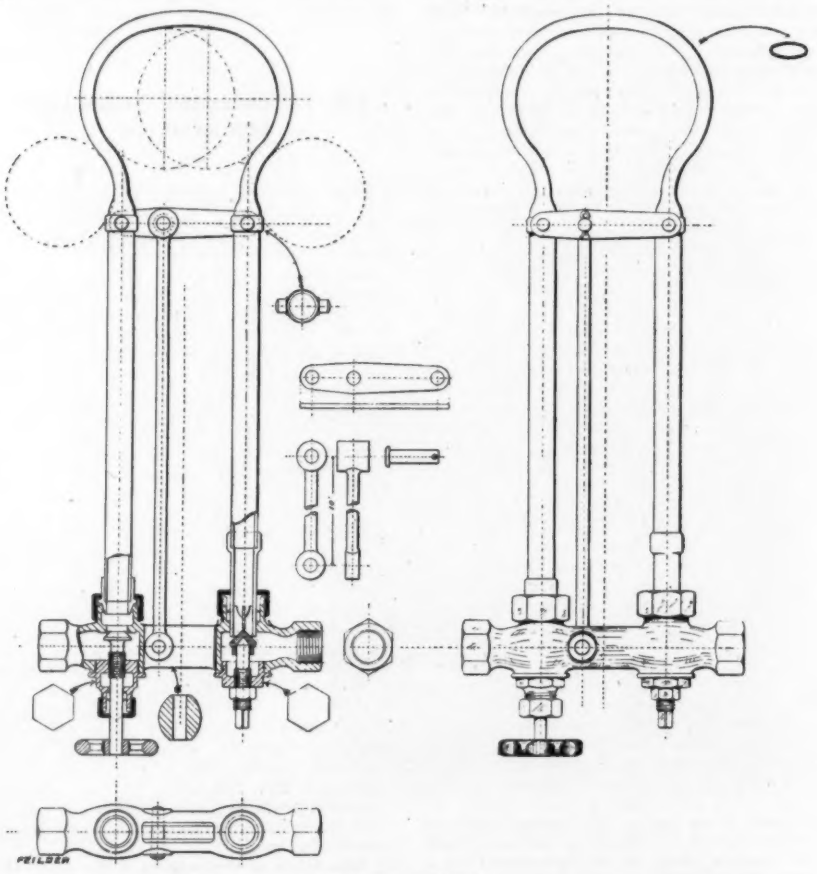
THE THERMOSCOPIC STEAM LOOP AND RADIATOR.

THE action of the Thermoscopic Loop Steam Trap is founded upon the well-known principle of expansion and contraction, and is constructed with a view to obtaining the greatest ratio of both. As will be seen from the engraving the trap, forming its own stop valve, can be shut off at the will of the user for examination or cleaning, and on the valve being opened the condensed water passes up, and circulating round the loop, passes out at the exit controlled by the second fixed, or adjusted, valve. So long as only water passes it has a free vent ; but on steam taking the place of the water in the loop, the leg of loop over the stop valve expands and tilts the lever, which, being fulcrumed to the body of the trap at a ratio of two to one, transmits its double movement to the second leg over the exit valve, which is depressed towards its valve at twice the movement of the first leg. Added to this is its own single expansion, so that the sum total of the movement is equivalent to the expansion of a tube three times the length of either leg. For example, a loop 12 ins. from centre of body to centre of the trunnions the levers are attached to, would have a movement equal to a tube one yard long, hence the excellence of the result obtained ; while the whole, being, after all, nothing but a single tube bent, possesses the reliability of an ordinary Bourdon pressure gauge, which is well known and appreciated for its orderly working and everlasting wear.

The action of the radiator is identically the same as the steam trap, with the exception of design, which is altered slightly to allow the loop to lie in an horizontal position, as shown in the engraving of a railway compartment, while the radiator in itself possesses the advantage of being able to keep railway compartments at any desired temperature, a desideratum quite unobtainable by ordinary methods.

On reading this statement engineers are

likely to ask why so much is claimed for this particular form of heating system. The reason is simply because in designing the loop radiator the designer had in view the fact that a fixed radiator, or heater, depending upon an independent steam trap to exhaust it of condensed water, is both practically and theoretically wrong, on account of the two refusing to work in harmony. The radiator body is practically lagged by the warmth of the carriage interior, and the trap cooled by the carriage exterior, the reverse to what should be consequent upon the outside atmosphere causing the steam trap to function for all it is worth extracting condensed steam, while the radiator returns the compliment by always being charged with live steam, to the discomfort of the travelling public. Where, then, is the sympathy, or practical utility, of such a combination? The answer is, nowhere. By replacing these two fixed elements with a loop radiator, we get an entirely different result, as the following will show.

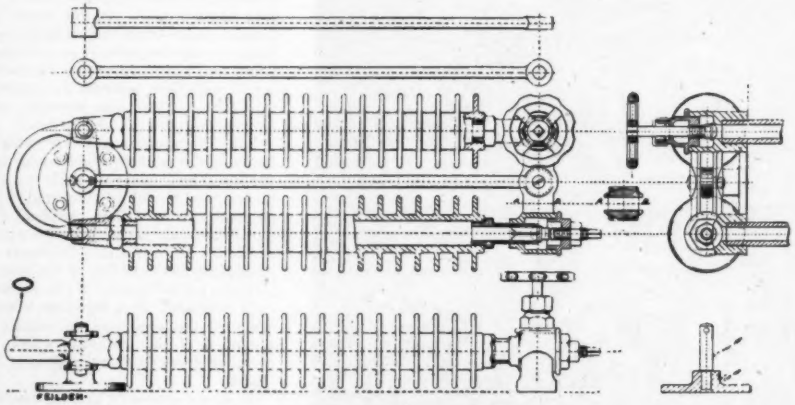


THE THERMOSCOPIC LOOP.

Instead of two mechanical forces diametrically opposed to each other, the loop radiator is a sympathetic, almost living instrument, endowed, at least, with latent feeling so necessary to the comfort of those for whose use it is intended. Every part of the loop

radiator acts in unison, caused by the body of same forming the medium for extracting and getting rid of the products of condensation. The natural outcome of this is, that according to adjustment a constant temperature is maintained, that is to say, the moment a predetermined temperature is reached the supply of steam is cut off from the radiator, making it impossible to overheat a carriage, as now happens when two independent mechanisms are employed. This not only gives great comfort, but economises steam. The foregoing explanation serves to show the folly of attempting to use a steam trap in connection with a heating device, and yet engineers are using them all over the railway systems of the world, without taking into consideration the primary idea of steam trap practice. A steam trap is for keeping mechanical and transmission systems clear of water of condensation so that the steam may be kept hot and dry with its mechanical efficiency unimpaired on arrival at the point of conversion into mechanical energy. This is not what is required with a radiator; the steam may be wet to its greatest degree of saturation, so long as it possesses sufficient caloric power to warm a compartment; consequently great economy, besides comfort, must result on account of the loop extracting every heat unit before parting with the products of condensation.

The makers of these interesting apparatus are Messrs. Wood, Fell & Co., 46, Upper Baker Street, London, W.C.



LOOP RADIATOR IN PLAN, ELEVATION AND SECTION.

HOMO CRUCIBLE STEEL.

THE enormous extent to which cast steel now enters into the details of mechanical and constructional engineering is one of the most striking indications which could be suggested of the industrial progress of the last two decades of this century. The greater strength and durability of steel, combined with its lighter weight, have led it to supersede iron for a wide range of purposes, for which experience and experiment have proved it to be eminently well adapted. In one direction alone it has asserted its superiority over iron in a marked degree; that is in connection with machinery for grinding such refractory substances as granite, stone, quartz, and the like. So great is the wear and tear upon the bottoms of grinding pans that iron does not show to advantage on the score of durability where the pans are constructed of it. The use of steel castings for pan bottoms ensures a longer life, while they can also be built thinner, and consequently lighter, than where iron is employed. In connection with clay working, steel is now successfully and very commonly employed for tooth-gearing, pug mill knives, wings and screws, crushing rolls, etc., as well as the dies for forming the bricks to shape, and the picks and shovels themselves. For quarries, even perhaps more than for brick yards, steel has become a necessity. The machinery of the quarry has to combine more particularly the qualities of strength and toughness, and although chilled iron has great hardness of surface it

does not give that proportion of toughness that is found in steel.

Few firms in the steel trade have laid themselves out more completely for clay-workers' requirements in the matter of steel castings than Messrs. F. L. Hansell & Co., of the Hansell-Canal Works, Eyre Lane, Sheffield. We believe that Mr. Hansell, the principal of the firm, was the first in the United Kingdom to introduce from Sweden, and until recently held the sole licence in this country for, the manufacture of "Mitis" steel castings, under the patents of Mr. Nordenfelt, of gun-making celebrity. Special plant was put down at the Canal Street

GROUP OF HOMO CRUCIBLE STEEL CASTINGS.

Works, Sheffield, under the superintendence of Swedish experts, for the production of these castings. They have now, however, been superseded by Hansell's "Homo" crucible steel castings, which mark an interesting departure in practical metallurgy.

These "Homo" castings are exclusively intended for lighter sectioned details, and particularly for those either of too intricate a nature to render it practicable to forge them, or where the subsequent machining would entail a prohibitive outlay. As a matter of fact the "Homo" steel castings are virtually non-machinable, and for similar reasons they are well calculated to resist abrasive action, such as occurs on the wearing parts of crushing, grinding, and other frictional machinery, which remark does not apply with equal force to many other special steels and only to a very limited extent at all to the best qualities of iron.

BELTING.

THE transmission of power is a complex subject, requiring an amount of technical knowledge not always met with, even among dealers in belting. For certain work—such as driving a spinning mule—nothing can beat good oak tanned leather; but when we come to machinery working out-of-doors, or in damp exposed places, in acid fumes or alkali, leather would be useless, and a textile belt is indicated. In many cases the ordinary sewn Cotton Dick, and what is known as hair belting, if well oiled, answers the purpose in a way. These are, however, not altogether perfect, on account of liability to stretch, and other drawbacks under certain conditions, and we are then brought back to the several textile beltings covered with gutta-percha or balata, rubber, &c. Once the fabric is covered with either of these materials the consumer is practically in the hands of the manufacturer, for the quality of the material used is hidden. It is, however, always open to the consumer to require a specimen of the material, which he can then dissect and investigate at his leisure.

It is not generally known that the breaking strain, the durability and the strength, or "life," of a textile belt depend almost entirely on the quality of the cloth used in its manufacture. In the case of gutta-percha and balata, melting as they do at a low heat, belts made up with these compounds are often inferior in certain situations, more especially in shops such as those in which wool is felted, or patent leather made, where the temperature must of necessity be kept high.

We are informed that the material of which "Teon" belting is composed, is made of the finest cloth procurable in the English market, cemented as well as sewn, and thoroughly protected by a composition which is unaffected by acids, alkalies, heat and damp, and whilst being sufficiently pliant is non-stretching. It is not our province to recommend the "Teon" or any other belt. Experience and the testimony of others must do this. But we believe we are doing our readers a real service by drawing their attention to actual facts in regard to power transmission which come to our knowledge.

SUP

Photo by the Feilden Press.

THE COLT AUTOMATIC GUN IN FIRING POSITION.

Recent American Inventions Introduced into Great Britain.

THE COLT AUTOMATIC MACHINE GUN.

THE chief points claimed on behalf of the Colt Automatic Machine Gun, now engaging the attention of military authorities in Europe, are as follows :—

Simplicity of construction.

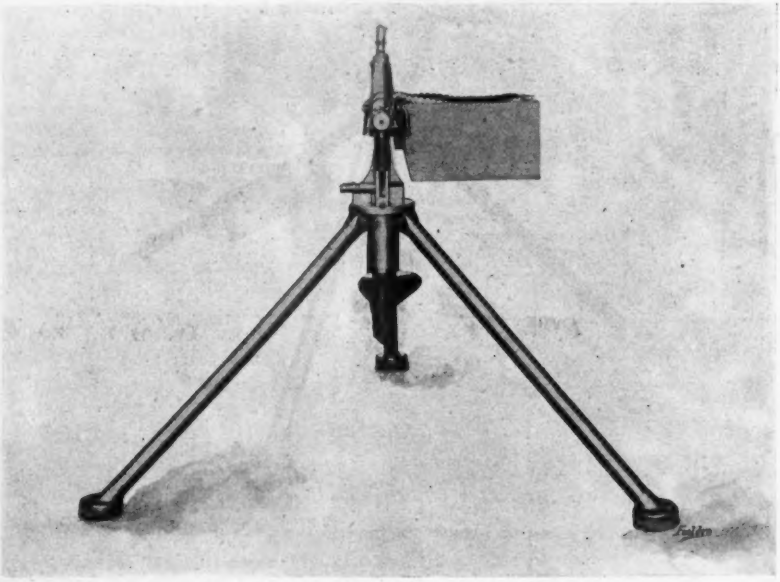
The ease and rapidity with which it can be repaired.

The absence of a cumbrous water-jacket.

Its portability.

Rapidity of dis-assembling and re-assembling its component parts.

The name of Colt is in itself sufficient to warrant the highest type of mechanical design and execution in any work with which their name may be associated. In the Colt Gun we see this reputation exemplified to the utmost. The gun may be described as a superb piece of mechanism. Its parts are comparatively few, and it is marvellous how skilfully they have been adapted to execute with unfailing regularity and precision an apparently complicated operation.



THE COLT AUTOMATIC MACHINE GUN : FRONT VIEW, SHOWING BORE, CARTRIDGE BOX, AND BELT OF CARTRIDGES.

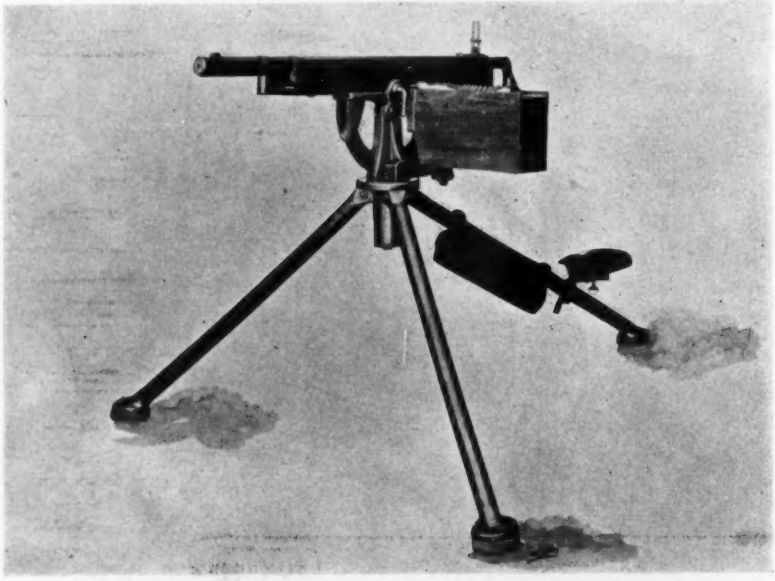
Briefly speaking, the Colt Gun, which has already made its reputation at the Sandy Hook testing grounds, in the Philippine Islands, and at the recent demonstrations before expert authorities at Runnymede, is a weapon which weighs altogether only 40 lbs. It is, as may be inferred from its weight, both compact and portable, its

length being 42 ins., width 2¾ ins., and depth 4½ ins. The gun is the most powerful arm in existence having regard to its weight and dimensions, discharging in continuous fire up to 450 rounds per minute of nickel-covered bullets of 175 grains weight with a muzzle velocity of 2,000 foot seconds. The energy of each bullet is equal to 2,000 foot pounds, and consequently the total energy imparted to its projectiles in one minute's fire is about 360 foot tons.

The gun is actuated by what is now known as the "piston" system, a system which, though not altogether new, is being regarded with increasing favour; that is to say, the force required to perform the several motions of firing, extracting, and loading is derived from the powder gases, a portion from these from each discharge passing through a vent in the bore near the muzzle, and controlling the mechanism by a lever which is actuated through the gas escaping through the vent-hole at each explosion. The piston is shown in our illustration appended, marked 35 and 36 on the drawing.

The operation of the gun is as follows:—

The cartridges are fed in by means of a belt to the chamber, the gas lever actuating the mechanism being swung by hand till the first cartridge is in position. The gun is now loaded, the action of the gas lever compressing the main spring connected with the hammer, the hammer being retained by the trigger. On the trigger being pulled the shot is fired. After the bullet has passed the vent, and before its exit from the muzzle, the force of the expanding powder gas acting through the vent upon the piston and gas lever, sets the gas lever in operation, which, in its turn, operates the breech mechanism—opening the breech, ejecting the shell, and feeding another cartridge in the carriage.



THE COLT AUTOMATIC MACHINE GUN: THREE-QUARTER VIEW IN FIRING ORDER.

The gas lever, returning to its former position, forces home the cartridge in the barrel, closing and locking the breech. If the trigger, instead of being released, is retained in firing position, the same operation will be repeated so long as cartridges are supplied.

It will be observed that the mechanical operations thus briefly described do not differ in any material respect from the practice already existing with regard to automatic machine guns now in use. It is therefore necessary to point out what, in the view of those who are responsible for the conduct of

the Colt Gun, differentiates it from the type now in use in this country.

In the first place it is pointed out that the Colt Gun is—and it is an assertion we are able emphatically to endorse—of the utmost simplicity. Its parts are so assembled that their complete dis-assembling and re-assembling is the work, even in almost inexperienced hands, of only a few minutes.

The barrel of the Colt Gun is of such strength that it will withstand the heaviest charges of nitro powders, and requires no water jacket, as owing to its thickness, it does not heat so rapidly as the light barrels of other systems. In addition to this point, the hammer of the gun is made to act as the piston of an air pump which forces a strong jet of air into the chamber and through the barrel, removing all residues and unburnt powder after the empty shell is extracted. The recurrent blasts of cold air, besides their cleansing efficiency, are instrumental in keeping down the temperature of the barrel. It is obvious that these points, which those responsible for the Colt Gun legitimately claim as peculiar to their weapon, are of considerable importance. It may be stated that over 8,000 rounds have been continuously fired from a Colt Gun without its accuracy being affected by either over-heating or the vibration incident to rapid firing.

Finally, the claims of the Colt Gun we have enumerated, and which, as we notice, are vouched by Mr. John Rigby, late of the Royal Small Arms Factory, Enfield, and Colonel Nuthall, ex-inspector Army Ordnance Department, are such as to justify the consideration which this splendid piece of mechanism is at present enjoying, and which in every way is worthy of the name and reputation the great firm associated with it have achieved.

The appended illustrations give sections of the Colt Automatic Machine Gun—Fig. 1 being a top view of the gun with both side plates on, and Fig. 2 a side view with the left side plate off. As will be seen, Fig. 2 (92), the gun consists of a heavy barrel attached to a receiver (88), which latter contains the mechanism of the gun. The gas piston and lever by which the mechanism of the gun is actuated, are shown at 35 and 36, being held in their places against the vent, when the gun is at rest, by retracting springs. The motion of the gas lever is transmitted to a slide (86) which moves backwards and forwards in a horizontal plane in the interior walls of the receiver. The cartridge extractor (82), pivotted to the slide, is caused by the rearward motion of the latter to draw a cartridge from the feed belt and to deposit it in the

THE COLT AUTOMATIC MACHINE GUN.

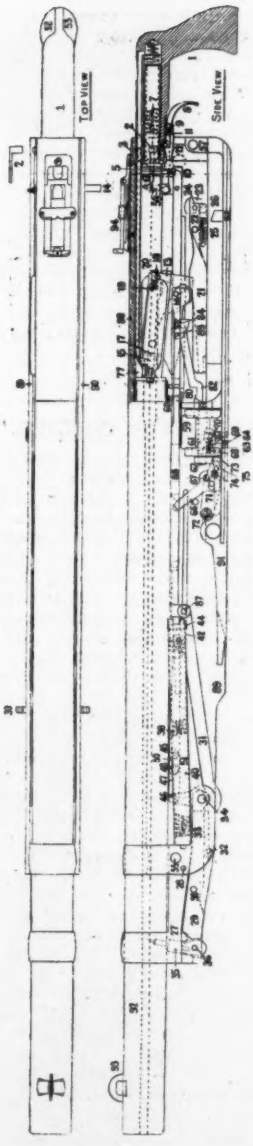


FIG. 1.—SECTIONAL TOP VIEW.

FIG. 2.—SIDE VIEW.

carrier (21). The function of the carrier is to receive cartridges from the receiver, to raise and present them in front of the breech bolt (13) for loading into the chamber. The breech bolt (13) is cylindrical in form and carries the firing pin (18) and extractor (15), and, in conjunction with the ejector (76), releases the cartridge case after firing, throwing it violently through the opening provided for the purpose in the right side of the frame. The handle (1) carries the hammer (6) with hammer-spring, sear-spring, and trigger spring. The air-pump is shown in a small channel in the upper part of the handle, a jet of air being forced through it into the interior of the gun by the rapid alternating motion of the hammer.

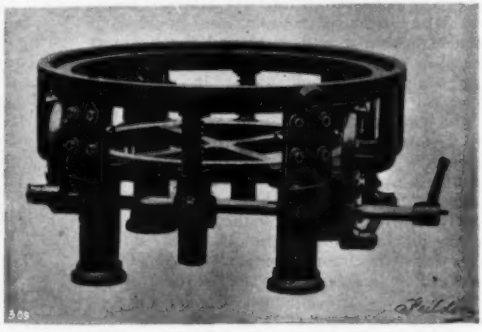
A NEW AUTOMATIC INJECTOR.

THE interior construction of the latest mechanical production in injectors or boiler feeders in the "Lee Ball Valve Automatic Injector" is new in mechanical features and arrangement. It is simple in construction, doing away with all complications, such as sliding parts and movable rings in connection with the jets, and substituting metal ball valves in the place of wing lifting or swinging check valves for the overflow. This injector is very broad and strong in working results, starting and working at 20 lbs. steam pressure, handling water on a lift up to about 130° Fahr., and delivering the same into the boiler as hot as 210° Fahr. They are very neat in appearance and design, well made and finished, and are constructed in fourteen sizes; they are thoroughly adapted to all styles of boilers, such as stationary, marine and farm or traction engine boilers. They are manufactured by the Lee Injector Manufacturing Company, Detroit, Michigan, U. S. A., and will no doubt incite our home inventors and manufacturers to go one better. Good as the American injector is, this does not seem impossible.

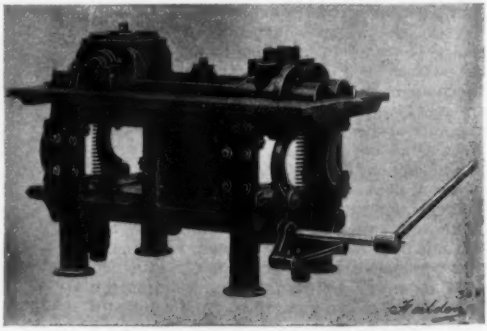
Some single issues of FEILDEN'S MAGAZINE will be worth the price of the whole year's subscription.—10/- forwarded *now* will ensure 12 issues, post free.

THE PRIDMORE MOULDING MACHINE.

THE Pridmore Moulding Machine, now being introduced into this country by the European Agency at 39, Victoria Street, Westminster, London, possesses features that appear to entitle it to some detailed attention. The chief idea present in the planning of any mechanical moulding machine, is to reduce the cost of making moulds; to obtain better results, and as a consequence, superior castings; and incidentally the rendering of the foundryman independent of skilled labour. Skilled labour, however, will continue to be imperative where single castings only are required; but where long



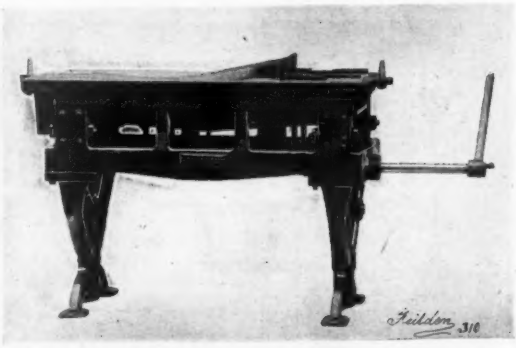
42-IN. ROUND DOUBLE SHAFT MACHINE.



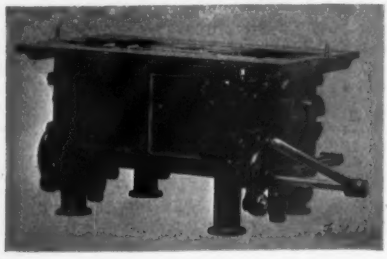
20 × 30 SQUARE DOUBLE SHAFT MACHINE, MOUNTED WITH WORTHINGTON STEAM-PUMP PATTERN.

series of duplicates are called for there is no question that machine work is in every way superior to hand labour in both economy and excellence of results.

The claims made on behalf of the Pridmore Moulding Machine may thus be summarised :—a saving of fifty per cent. over ordinary power pressure machines, and a saving of seventy-five per cent. over hand labour. It is asserted that the average worker can put up and pour 1,500 pounds of good castings with the Pridmore Moulder per working day of ten hours ;



20 × 48 MOUNTED WITH PATTERN, READY FOR PUTTING ON MOULDING BOX.

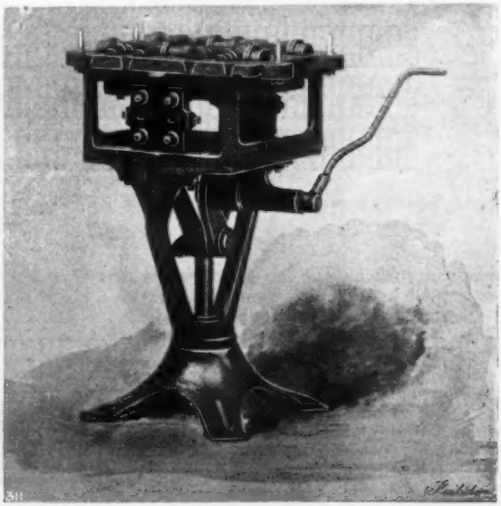


20 × 30 SQUARE DOUBLE SHAFT MACHINE WITH PATTERN DRAWN.

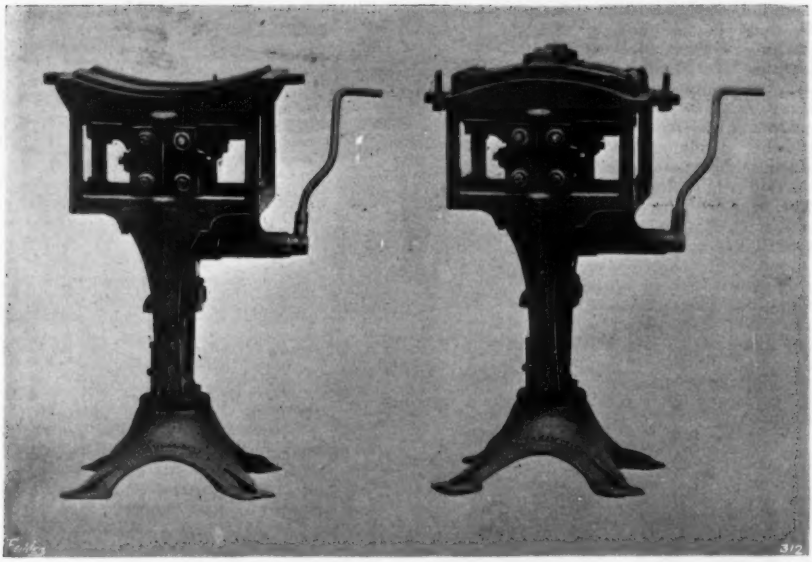
and that the average loss for imperfect castings is less than three per cent. The machine itself is made in ten styles, and over one hundred sizes, turning out castings weighing from a few ounces up to two tons.

We illustrate herewith a few types of the Pridmore Machine. As will be seen, the machine is rammed by hand. The pattern is drawn through a plate, while the machine itself is moved forward as the sand and flasks are formed into moulds and placed on the floor in the rear of the machine. The objections against the mould-squeezing plant, whether operated by hand, compressed air, hydraulic or mechanical power, are specified by the inventor of the Pridmore Machine as follows :—(*a*) That they require skilled attendance. (*b*) That a mould cannot be properly rammed excepting that it contain low flat patterns with sloping corners. (*c*) That repairs are frequent and expensive. (*d*) That the cost of power machines, compressors, conveyors, piping and foundations, with the fuel and attendance required, produce a large first cost, and large comparative cost of operation, from which the machine now under notice is entirely free

One of the chief features associated with the Pridmore Moulding Machine is the manner of its operation. As we have already mentioned, the machine is drawn after the moulder as he progresses, the sand and flasks as they are made into moulds being left behind him. The difference

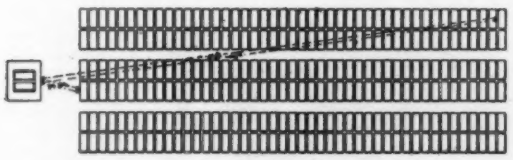


12 × 12 MACHINE MOUNTED WITH CHAPMAN VALVE PATTERNS



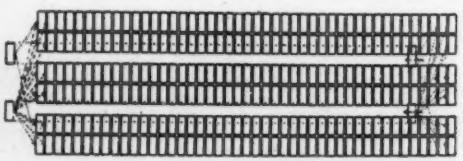
12 × 12 MACHINE MOUNTED WITH BRAKE BLOCK PATTERN.

entailed by this procedure between the Pridmore and the ordinary practice where the moulds are put up on a bench or on a stationary machine at one end of the floor is expressed by diagram shewn below. This is a plan of a floor in a foundry filled with 270 arc lamp frame moulds, each mould being 12 in. × 28 in. × 8 in. The question is, supposing these moulds put up on a bench or on a stationary machine at one end of the floor, how far are the moulders required to walk in placing these moulds in position? Measuring, it is found that the distance in a straight line from the bench or machine to the farthest mould is 55 ft., to the nearest mould is 5 ft., the average distance is 30 ft., or there and back to the bench or machine is 60 ft., and as 270 drags or nowels and 270 copies have been placed on this floor, these moulders have walked 540 times 60 ft. or 32,400 ft., or 6 miles and 720 ft., which is, as stated, a great deal of hard work in itself when it is remembered that heavy half moulds have been carried one-half of this distance.



STATIONARY MACHINE—270 BOXES TO BE CARRIED TO AND FROM THE MACHINE.

On the other hand, by the use of the Pridmore Machine, it is claimed, and apparently with justice, that the distance traversed under the same conditions would be 6,480 ft., or only one-fifth of that covered by men working according to the usual system.

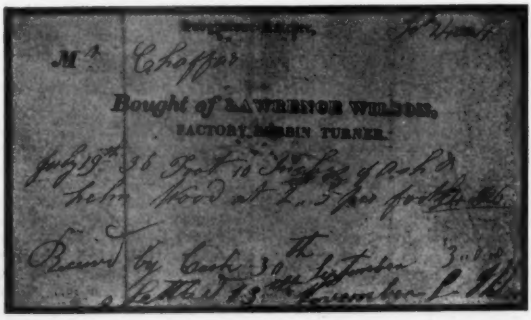


PAIR OF PRIDMORE MACHINES—WORKED DOWN THE FLOOR. MACHINES TRAVEL 50 FEET ONLY, SAVING CARRYING BOXES AND MOULDS.

Every invention calculated to aid in the efficiency, and reduce the cost of production, is, in these days, entitled to the closest attention by our manufacturers. Among modern appliances for expediting and economising, the Pridmore Moulding Machine, we think, will be held to be deserving of the share we have given to its description.

FACTS ABOUT THE BOBBIN INDUSTRY.

IT may be that the average mind does not often dwell specifically on the subject of bobbins, but it must be plain to the student of manufacturing industry that, in view of the extent and cosmopolitan character of the textile trades, the consumption of bobbins must be enormous. The examination of some data referring to the capacity in bobbin and shuttle production of the largest firm of bobbin makers in the world—Messrs. Wilson Bros. Bobbin Co., Ltd, of Cornholme Mills, Todmorden; Atlas Works, Garston, Liverpool; and 14, Market Place, Manchester—serves to indicate the extent and industrial importance of the bobbin trade. The business we have mentioned was founded in 1823, and, as the result of continuous developments, in one direction and another, the two works of the company now afford employment to 1200 workers. Some idea of the extent of the business will be gathered from the facts that the average consumption of timber at the works was over 2,000 tons per month, which resulted in a production of 35,000 gross, or about 5,000,000 bobbins per month. The Garston works are the newer of the two, and are very fully equipped with modern machinery, the complement of circular saws alone, for dealing with the timber in the rough, is over forty. In the process of manufacture at Garston and Todmorden about 50 per cent. of the bulk of the raw material is used, and 75 per cent. of the weight goes to waste. Much of the heavier waste is utilised for fuel, while the wood turnings are used in the production of "fire-lighters." The bobbins and shuttles manufactured are recognised in the textile trades of the world as being of the best quality and most accurate workmanship, and much of this is not only due to the improved machinery employed, but owing to the immense facilities possessed by the firm for seasoning and storing the vast quantities of timber used. In competition at international and other exhibitions throughout the world the company have been awarded 32 gold medals and diplomas, and it should be mentioned that they were the original inventors of shield protectors and metal mountings, which are now universally used on all kinds of bobbins and tubes. The principal partners are Messrs. J. H. and H. W. Wilson, the son and grandson respectively of the late Mr. Lawrence Wilson, the founder of the business. It will be interesting to many if we draw attention to the reproduction of the unique invoice which appears herewith. It represents a reduced facsimile of the first invoice issued by the founder of the firm. The few notes we have given will suffice to indicate to what importance a, comparatively speaking, subsidiary industry is capable of developing under wise administration and the judicious employment of capital and enterprise.



REDUCED FACSIMILE OF THE FIRST INVOICE ISSUED BY THE LATE MR. LAWRENCE WILSON, THE PROJECTOR OF THE WORLD-FAMED FIRM NOW KNOWN AS THE WILSON BOBBIN CO., LTD., TODMORDEN, LANCS.

INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION

FROM ALL SOURCES.

CIVIL AND MECHANICAL ENGINEERING.

Another New Smoke Preventor.—To the designing of new smoke-preventing arrangements there is no end, and still one more is being introduced by Messrs. Rossell & Co., of Sheffield. It is well known, of course, that bituminous coal cannot be burned smokelessly except in furnaces arranged so that the products of combustion sweep over the surface of the fire, and become thoroughly mingled with a proportion of fresh air, admitted preferably at the door. When thus mixed it is essential that the gases be at a sufficient temperature to ignite, that they have space in which to burn freely, and be not unduly cooled down. The new device is based on the admission of air for a short period after each fresh charge of fuel. This air is required by the hydro-carbon gases which are distilled off each fresh charge, and it is necessary that air admission should cease gradually as the gas supply becomes exhausted. The apparatus consists of a number of louvres in the door of the furnace. Each louvre carries a central bulb, and these bulbs rest one upon another in such a way that pressure on the lowest will raise all and open the louvres. In opening the furnace door the requisite upward pressure is supplied by means of a bell crank and a bracket, which presses on the bell crank lever and opens the louvres and raises an oil cataract or dash-pot piston. Closing the furnace door sets free the louvres to fall, but they only do so slowly under the cataract action, which is controllable by means of a cock in the bye-pass.

Fluid Castings.—It is widely recognised in foundry practice that the importance of strengthening and refining iron and steel castings can hardly be over estimated. Some experiments which have been quietly but systematically conducted along the North-west Coast, with what are stated to be most satisfactory results, are worthy of especial notice. Two or three of the so-called earthy minerals in certain proportions are roughly ground, and the foundry ladle bottom is coated or lined to the depth of 4 ins. In a few minutes the ladle of molten metal becomes scummed. This is skimmed off, and a small quantity of the "Ferfluorine," as it has been named, added. The result is that any class of pig will flow "as easily as butter-milk," to use the words of the founder, and there are no blow-holes, and upon breaking the castings the influences of the "Ferfluorine" are at once apparent. The cost per ton is stated to be nominal. Further experiments are to be made. It is, however, said to be sufficiently proved that at a cost of 1*s.* 6*d.* to 1*s.* 9*d.* per ton castings of both iron and steel can be very greatly strengthened, and it is hoped that from cast metal malleable may be directly obtained simply by adding to the ladle certain proportions of "Ferfluorine," another earthy mineral, and this, without any increase in the cost. The results of the further experiments will be looked forward to with much interest.

A New Swedish Engineering Industry.—According to a British consular report from Gefle a new engineering concern is in course of formation at Falun, where works for the building of locomotives and other railway rolling stock are to be erected. The new company is intended ultimately to turn out about 50 locomotives and 1,500 goods wagons annually. To dispose of a production of this magnitude, recourse must presumably be had to an export trade, as it is scarcely likely that Sweden can absorb the whole of this production alone, over and above the output of the works already in operation. The Swedish State Railway Administration have lately been obliged to hire goods wagons from Germany and purchase locomotives from America to meet the demands of the increasing traffic. In this respect the Swedish railways find themselves in a position much like that of some of our own railways.

Canal Boat Haulage.—While it is surprising that so little has been successfully accomplished in the way of improving existing systems of canal boat haulage, it is encouraging to note that efforts are being unostentatiously made in various quarters to make an advance upon the methods which at present prevail. A new system of haulage has just been adopted in Belgium. It consists of a vehicle like a tricycle, to which is attached by an ordinary towing rope the canal boat. The vehicle runs along the bank and takes the current from two overhead conductors strung by the side of the towing path. In Germany still another system is

to be tried, which will consist of an electric locomotive running along a narrow-gauge railway, the necessary current being taken from an overhead trolley. Another system recommended by *Electricity*, of New York, consists of electric motors running on cables carried on posts on the banks, and to which the boats are attached by two ropes. The motor may be controlled from the deck by means of two wires.

Interesting Wire Rope Test.—A foreign abstract in the *Proceedings* of the Institution of Civil Engineers describes a test of a large wire rope, measuring in outside diameter 90 millimetres. The rope consisted of six principal strands and a central core. Each principal strand consisted of six secondary strands and a hemp core; while the secondary strands each contained thirty wires in two layers of eighteen and twelve round a hemp core. The rope therefore contained $6 \times 6 \times 30 = 1{,}080$ wires, each 1·46 millimetre (0·058 in.) diameter. The tensile strength of the wire was 116 tons per square inch, and if the full strength of the individual wires had been obtained, the rope should have had a breaking strength of 330 tons. The rope was bent round two special castings which were attached to the testing machine. One end of the rope was lashed by three pairs of screw clamps, each with eight bolts 2¼ in. diameter; the other end was spliced. Great difficulty was experienced with the clamp fastenings, owing to the contraction of the rope as the load increased. The circumference was 288 millimetres before the application of the first load, and shrank to 252 millimetres with 150 tons load. The rope ultimately broke near the end of the splice with a load of about 250 tons, giving a coefficient of strength 0·75.

The Eiffel Tower, which is the most enduring and obtrusive reminder of the Paris Exhibition of 1889, is now in process of undergoing a complete renovation in preparation for next year's Exhibition. It has been decided to paint the entire structure with an enamel paint in five shades. The dome and summit are to be of a light yellow chrome, and the shades will graduate to the pedestal, which will be a rich dark orange. For the two coats which are to be applied upon the Tower, nearly 50 tons of enamel paint will be employed. As an example of painting accomplishment this work will be remarkable.

A New Feed-water Heater. — Messrs. McPhail & Simpson, of Wakefield, whose names are now so closely and honourably associated with valuable achievements in connection with the economical employment of steam power, have introduced a new feed-water heater, which, in several respects, marks a novel departure from conventional lines. The feed to the boiler is allowed to fall in a divided shower through the steam space of a vertical egg-ended vessel, and then over a series of trays which serve to separate the lime salts. The idea on which this auxiliary feed heater is based is that of securing that the boiler feed, no matter how it may first be heated by an economiser or by other means, shall be exposed to steam at full boilure pressure, in order that it may finally pass into the boiler at full temperature. A boiler thus fed has simply to supply the latent heat of evaporation.

Liquid Air for Industrial Purposes.—Dr. Hampson, whose name has become more or less familiar through his work on the production of liquid air, has been giving an exhibition of his apparatus at the chemical works of Messrs. A. Boake, Roberts & Co., of Stratford, London, E. After a preliminary account of the construction of his machine, and the principle on which it works, Dr. Hampson performed some experiments with liquid air and liquid oxygen manufactured on the spot, and then proceeded to discuss the question how far there is any probability of liquid air being applied to industrial purposes. He pointed out that the cheapest rate at which liquid air had so far been manufactured, even in America, was 10*d.* a gallon, or, say, 1*d.* a pound. Taking everything into consideration, he calculated that, pound for pound, liquid air had about the same practical cooling effect as ice, which, however, cost very much less. Similarly, he showed that, as a motive agent, steam was infinitely less expensive. So far as he could see, there was no prospect whatever of liquid air being utilised as an agent for the development of power or for refrigeration.

New System of Malleable Iron Casting.—There are at present in progress in the iron-founding districts of the Black Country a series of experiments intended to result in the establishment on commercial lines of the production of malleable iron castings on what is called the "stump" process. Hitherto only common iron has been produced by this method, which dispenses with the trouble and cost of moulding each article in sand, and, as a consequence, boys and girls, under proper supervision, can do the work as efficiently as skilled artisans, and at a great reduction in cost. Should the experiments—which up to now are very promising—ultimately succeed, the result will be a most important development in the malleable iron foundry trades, and one which may have very far-reaching results.

New Dry Dock for the Thames. — An important addition to the ship-repairing accommodation and facilities of the Thames has been made by the opening of a spacious new dry dock on the site of a previous one, by Messrs. Fletcher, Son and Fearnall, of Union Dry Docks, Limehouse. The new dock is 440 ft. long, 79 ft. broad at the coping, 60 ft. at the entrance, with 22 ft. of water on the sills at high tide. It is provided with an installation of pumping machinery in duplicate, with gas power developing some 340

horse-power by Crossley engines. The powerful Gwynne pumps enable the dock to be emptied in between one and two hours, instead of the operation taking a half day, as under the old gravitation system. The firm of Fletchers is, of course, a household word by the riverside, the original William Fletcher having established himself at Shadwell as a ship repairer in the seventeenth century. The opening of the present dock represents a forward step in dock engineering, inasmuch as it takes the place of a dry dock constructed in 1818. The then head of the firm, Mr. Henry Fletcher, acquiring the present premises, and being desirous of taking advantage of a breach in the river as a dry dock, found exceptional difficulties in the way. He therefore purchased an old East Indiaman, the *Canton*, sunk her, fastened her down with through piles, erected gates at her stern, and for seventy years thereafter this old specimen of the walls of England has served as a dry dock, the only objection to it being the restriction of size. In the construction of the present dock it was, of course, necessary to take up the *Canton*, when it was found that the vessel, which was built of English oak, and was a century old, had its timbers in such perfect preservation and so tough, that each one had to be split out. The opening ceremony was performed by Sir W. Fortescue Flannery, M.P., and immediately after the dock was opened the s.s. *Hollinside* entered for repairs. No time, therefore, was lost in starting practical operations.

A Shorthand Writing Machine.—A recent demonstration of the practicability of an ingenious little instrument, called the Stenotyper, suggests many possibilities in a new direction. The machine somewhat resembles a typewriter. Each time any letter is printed a full line of that letter strikes the inking ribbon against the paper, but only the one letter prints which strikes the ribbon and paper where there is a solid anvil or backing block, as the inking ribbon will only print when brought sharply into contact with the paper. As the paper has no backing except at this one spot, the remainder of the letters do not print. The anvils are built on a spiral shaft, which turns one step with the printing of a letter, throwing a new block into position, ready to receive the imprint of the next letter. This system does away with the shifting of the carriage, necessary in most typewriters, before commencing a new line, as, when a line is complete in the stenotyper, the first block at the other end comes into position. There are six keys, which may be struck singly, or any number together, ensuring the printing of characters representing one, two, or more letters of the alphabet. For greater speed a system of abbreviation is adopted. The makers claim for it that it will supersede shorthand, being much easier to learn, and the "note" can be read by any other operator, and it is said that a speed of 200 words per minute is not beyond its capabilities. It is practically noiseless, and its size and weight are inconsiderable, permitting it, if necessary, to be worked on the knees of the operator.

New Iron Founding Industry in Italy.—The establishment of an extensive new iron foundry at Elba in Italy, is a matter which should not escape the attention of British producers of pig and other iron, and of ironfounders' material. The chief object of the proprietary company is the production of cast-iron, and the company's formation is justified by the fact that, owing to the activity that reigns in Italian metallurgical works, the imports of this article have been gradually increasing during the last few years. On the basis of the latest available figures, it is reckoned that Italy will import this year about 18,000,000 lire worth of cast-iron alone, without taking into account the large quantity of iron and other metals imported in a partly-manufactured form. The new enterprise will therefore constitute a big stride towards the emancipation of the Italian metallurgical industry, and as the largest portion of the 15,000,000 lire of capital is understood to have been subscribed by the powerful group of its foreign promoters, the company will be, financially, a strong one.

A New Fire Alarm.—The types of fire alarms now available are numerous, but they are not generally quite satisfactory or dependable in working. A new alarm—Pearson's Thermostat—impresses one as being possibly at last a perfect apparatus for detecting and reporting fires. In an establishment fitted with this ingenious contrivance a bell will ring as soon as the temperature in any particular room or floor rises above the normal maximum, and, what is more, the exact room or other part of the building in which the fire is situated will be indicated by an indicator-board. At the same time an alarm will be transmitted to the nearest fire-brigade station. The Pearson system is by no means the first of its kind, but it is the first that seems to be dependable. The thermostat works on the same principle as the thermometer. It has a bulb and tube containing mercury, and is fixed near the ceiling of the room where an increase of temperature is always most perceptible. The expansion of the mercury causes it to come into contact with an ingenious arrangement of wires, which transmit the alarm to any particular part of the building, say the watchman's box, and also to the fire-brigade station. The great merit of the Pearson system lies in the fact that the mercury in the bulb of the thermostat is so treated as to be proof against the action of oxygen, which has always been fatal to the efficiency of other systems. Pearson's system has already scored many successes, notably its adoption by the General Post Office, after a series of tests lasting over eight months.

A New Piston Packing.—Still another piston packing has been invented by Mr. James Airey. It is primarily intended as an improved means for preventing the escape of fluid between pistons or piston-valves and the walls in contact with which they travel. A ring of suitable metal fitted with segments of a metal of more expansive power at the same temperature surrounds the piston, and

on the outside edge of this ring the packing-pieces are fitted by grooves, dovetails or projections in order to prevent their lateral displacement. The segments are kept in place endwise on one side by a flange on the piston body, and on the other side by a junk ring. A spiral or coiled wire spring placed between the rings presses them against these parts.

An Immense Weighbridge.—What is understood to be the largest weighbridge in the kingdom is about to be placed at Ebbw Vale, for the purpose of weighing steel rails in connection with the Ebbw Vale Company's rolling mills. Hitherto it has been usual to couple ordinary short weighbridges together for the purpose of weighing twin bogies, but the new weighbridge will obviate this, and will be perfectly accurate. It will be 70 ft. long and 6 ft. 2½ in. broad, fitted with steel rails of the ordinary British gauge, and it will have a capacity of 60 tons. A special feature of this machine will be that a shorter load than 70 ft., placed at any position of its length, can be weighed with perfect accuracy. The weighbridge was designed and made by Messrs. Henry Pooley and Son, Limited, of London and Liverpool.

Heavy Foundry Work.—Some large and difficult casting operations were recently successfully carried out by Messrs. Fraser and Chalmers at their Erith works. One heavy job consisted of the casting of the grooved drum for a deep-mine-hoisting engine, the drum being 25 ft. in diameter and 21 ft. 7¾ in. long. It was cast in three pieces; the middle cylindrical section 25 ft. diameter and 7 ft. 1¾ in. long; the two conical end sections, each 7 ft. 3 in. long and from 16 ft. to 25 ft. diameter. The thickness of the metal at the bottom of the grooves was only ¾ in. Each conical section has thirty-three spiral grooves for 2125 ft. of rope, and the centre section has forty-nine grooves for 3875 ft. The drum will therefore carry 8125 ft. of 1½ in. wire rope. Each section was cast in one piece, but afterwards divided into six segments for convenience in handling and shipping, the segments being bolted together with inside flanges. This great drum shell is mounted on spiders on the drum shaft. The castings were made in a loam mould, 37,000 bricks and 88 tons of iron being used in the mould and cores, bottom plates, lifting plates, and binders. Each core weighed over 100 tons, and was made in three pieces for ease in handling. Each section of the drum required the pouring of 35 tons of iron.

MARINE ENGINEERING AND SHIPBUILDING.

New System for Fresh-water Production.—A new method of producing fresh water on board steamships has been devised by Messrs. Caird & Rayner, who have in the past done much useful work in connection with the mechanics of marine engineering. In this case the exhaust steam of the auxiliary engines in steamships for feed pumps, circulating pumps, generating electricity, compressing air, or forcing water, is to be utilised by an invention of this firm for producing fresh water. Usually the steam used for evaporation is taken direct from the boilers or from a donkey boiler, and also, the exhaust from the auxiliaries for the above purposes is allowed to escape at considerable pressure. In the new arrangement, a receptacle is provided into which the exhaust of all the auxiliary engines is led, and from which the steam then passes to an evaporator. The receptacle is provided with a safety valve, and steam escaping by it is led to the main condenser. The fresh-water condensing apparatus may be used for several purposes. The water resulting from the condensation of the exhaust steam being used as feed-water for the boilers, whilst that resulting from the condensation of the vapour generated by condensation of the exhaust steam may be used for drinking and culinary purposes or for feed make-up requirements.

The Rapid Coaling of Ships.—Smartness in coaling steam vessels, and war vessels in particular, is recognised as a matter of the first importance, and during the past few weeks, some exceptionally clever work in this particular has been accomplished by ships of the Channel squadron. Perhaps the most noteworthy example was that of the *Diadem*, which recently eclipsed all her own previous records, and almost beat the big record made by the *Majestic*. The *Diadem* had 1,500 tons of coal to take on board, and managed to complete the task in five minutes less than 15 hours, making an average of something over 100 tons an hour. Coaling was commenced at 5 o'clock in the morning, and although some delay was experienced, owing to the continual breaking down of the steam winches of the collier alongside, the operation was finished by 9.15 P.M. the same day. Out of this time one hour and twenty minutes were taken up for meals. The admiral at the Nore complimented the *Diadem* on her smart feat. Earlier in the month the *Majestic* took in 1,300 tons of coal in ten minutes under fifteen hours. The same ship had previously coaled at the rate of 161 and 172 tons an hour, but for so large a quantity, and having regard to the fact that the coal was shipped on one side only, the performance surpassed any previous record.

The Holland Submarine Boat, of which so much has recently been heard in naval and marine engineering circles, is to have her final test by the Government very shortly in order to decide definitely whether the strange craft shall or shall not be adopted by the Navy Department for use in warfare. The Secretary of the Navy has signified his intention to set a date for the trial, which will be held at Peconic Bay, Long Island. It will be a different test from any of those yet undergone by the submarine boat, and will determine practically her value as a destroyer. The chief

claim of the inventor has always been that the boat could approach an enemy's ship unseen and destroy it. In all tests heretofore the Holland has contented itself with a dummy torpedo, but in Peconic Bay a real Whitehead torpedo will be fired at a target. Much interest is evinced in the forthcoming crucial test.

The s.s. Inchkeith, which has just had her official trial, is noteworthy as being the second steamer in which has been fitted a set of Mudd's patent five-crank quadruple-expansion machinery by the Central Marine Engine Works of William Gray & Co., Limited, for Messrs. Hamilton, Fraser & Co., of Liverpool. The *Inchkeith* is a handsome steel screw steamer taking Lloyd's highest class, and is 348 ft. in length, 47 ft. in breadth, and 28 ft. 1¼ in. in depth; her dead-weight capacity being 5,600 tons on 22 ft. 5 ins. draught. The engines are of 17, 24, 34, and two of 42 ins. diameter, with a piston stroke of 42 ins. The boilers are of the ordinary cylindrical multi-tubular type, built for a working pressure of 260 lb. per square inch.

German-built War Cruiser of Japan.—The first warship of any importance which has been built in a German yard for the Japanese Government has been launched from the Vulcan Company's yard at Stettin. The length of the *Yakumo*, the new cruiser in question, is 426 ft.; beam, 64 ft.; draught, 40 ft. The cruiser has a displacement of 9,850 tons and a mean draught of 23·9 ft. The engines will indicate 11,200 h.p., giving a speed of 18 knots; but they can be worked up to 15,500 h.p., giving a speed of 20 knots. In addition to its other armament, which will be supplied by Sir W. G. Armstrong, Whitworth & Co., Limited, the cruiser will have five torpedo tubes, four of which are under water and fire broadside, while the fifth is above water in the bows.

New American Liners.—The American Line are building four new steamers for the Atlantic trade—two at Clydebank and two at Messrs. Cramp's yard, Philadelphia. The first will be ready about September or October next year, and the others will follow at about two months' intervals. They are 560 ft. long, 60 ft. beam, and 42 ft. deep, about 13,000 tons gross register, and when fully loaded will have a displacement of 20,000 tons. The vessels will be fitted with twin screws, and the engines will have 10,000 h.p. and a speed in actual service of 17 knots. The vessels are intended for the Red Star Line running between New York and Antwerp, calling at Southampton.

Italian Shipbuilding Activity.—In a report on the finances of Italy, by Sir G. Bonham, Secretary to H.M. Embassy at Rome, reference is made, in dealing with the dangers to which the Italian Budget is exposed, to the fact that the grants in aid of shipbuilding and the bounties on navigation in the Italian mercantile marine amount to at least 8,000,000 lire (£320,000), and will probably amount to 9,000,000 lire (£360,000) or more. In the shipbuilding yards in Liguria, vessels, the report states, are being built which will add more than 50,000 tons to the mercantile fleet. This activity is extending to Leghorn and will probably extend to the south of Italy. There are many inducements for this extension of shipbuilding, which is doubtless to be encouraged in the interests of Italian commerce, although the results of the system of premiums and subventions may be far from favourable to the Italian Treasury. The sums thus expended are not, however, entirely lost, as it is calculated, the report adds, that sums amounting to three-fifths of the expenditure find their way back to the Treasury in the form of anchorage and other dues.

Shipbuilding in Germany.—As in Great Britain and in the United States, so in Germany, shipbuilding activity is on the ascendant. Our Consul-General at Frankfort-on-Main reports to the Foreign Office that the German shipyards were well occupied in 1897, so that they were not able to fulfil all new orders, and had to leave some to the greater capacity of British shipyards. In 1898 this busy state of affairs continued. The well-known Blohm & Voss yards built five steamers, and a ship machine plant with 35,000 registered tons in round figures. For 1898 there remained in construction 11 steamers of about 83,529 registered tons, as well as a ship for the Imperial marine. The Hamburg-American Line gave orders in 1898 for 10 large steamers and four large steam vessels at various German shipyards. An order for four big freight steamers was at the same time given to England. The North German Lloyd had nine steamers of 78,380 registered tons in course of construction. Warships for foreign account were being built by three German shipyards; and in course of construction for foreign navies there were in 1898, 22 battleships, viz., one armed cruiser, three big protected cruisers, 10 torpedo-boat destroyers, and eight torpedo-boats.

ELECTRICAL WORK.

An Electrical Mileage Recorder.—Some particulars have been given in *Indian Engineering* of a device for recording the running condition of a railway invented by Mr. B. L. Rajak, B.C.E., the Assistant Engineer at Pad Idan, Sind. It is proverbial that an Inspector of Permanent Way can with difficulty be persuaded to believe that the running condition of his road is worse than that of his neighbour's, however much this may actually be the case. Instead of treating the Permanent Way Inspectors to a bare opinion on their road, the design of this invention is to give a graphic record of the condition of the road. The instrument, in the inventor's opinion, is far from being perfect, but, as it is, it serves the purpose

intended well enough. Given the same speed approximately and the same carriage (not by any means impossible assumptions in the working of a railway) it delineates the good, bad or indifferent road sufficiently faithfully to enable Permanent Way Inspectors to see and judge for themselves and be convinced of the relative merits of different sections beyond a doubt. The instrument gives the best results when it is placed in the last carriage and when that carriage is not a bogie. The operator is to note down the mileages.

Electrical Transmission of Power.—The electrical transmission of power in connection with mining operations is making rapid headway. In America it bids fair to surpass the electric railway business in magnitude. Over $100,000,000 have already been expended for this purpose in the various mining industries of the United States. But far and away the most important long distance electrical power enterprise is that of the Niagara Falls Power Company, in the utilisation of part of the energy of the great cataract. By means of its plants on both sides of the Niagara River, this company will develop 350,000 horse-power; and its power house, canal and tunnel on the American side are adequate to the production of 100,000 horse-power of electrical current, generated by the Tesla two-phase system. An expenditure of $3,000,000 has been made, and is now yielding an income. Part of the current is being used in the electrical manufacture at the Falls of aluminium and carborundum, and a large manufacturing city is beginning to form about a mile above the Falls, free from smoke, dust, and gases, all the energy being distributed silently over hidden wires. Arrangements have been made by which Buffalo, twenty-two miles away, is to receive this current in large quantities, the price being $18 per horse-power at the Niagara end of the line; while it is estimated by experts that the current can even be delivered 300 miles away in Albany, to compete on equal terms with the power of steam-engines on the spot, using coal at $3 per ton. The boats on the Erie Canal are also to have this power, at a rate of $20 per horse-power per year, and vital improvement in canal haulage is expected. The first trials in this direction have been made, with notable success. All over the United States the example at Niagara is being imitated, and millions of dollars are pledged for similar water-power utilisations, while a great many such plants have gone into commercial operation.

The Cowper-Coles' Regenerative Electro-Galvanizing Process.—This improved process is now, we understand, in successful operation at the works of the Germania Shipbuilding and Engineering Company, Ltd., at Tegel, near Berlin, and is employed chiefly for the coating of boiler tubes, such as those used in the "Thornycroft" water-tube boilers. A similar plant is in course of erection for the Imperial German Dockyard at Wilhelmshaven. In the latter case, the dynamo, which is capable of giving 2,000 ampères at six volts, is direct coupled to a three-phase motor, the motor being provided with a pulley for driving a small air compressor. The current is conveyed to the depositing tanks by means of bare copper strips. The circulation of the electrolyte is thus effected: the acid solution falls over a wooden sill placed in one corner of the zincing tank into the overflow tank, it then flows into the compressed air tank, when air is blown in and the solution is forced up into the regenerating tanks. A non-return valve is placed in the pipe connecting the overflow tank to the compressed air tank. The supply of air to the compressed air tank is regulated by means of a three-way cock actuated by a float placed in the regenerating tank, in such a manner that when the air is cut off from the compressed air tank, it is blown through the solution in the zincing tank, thus keeping it agitated. The zinc dust is placed in the regenerating tanks on wooden grids covered with cocoanut matting, being mixed with finely divided coke or sand. The regenerated electrolyte returns to the zincing tank.

A New Industry at Nyköping, in Sweden, is the manufacture of glow lamps for electric lighting purposes. During last year something like 20,000 were imported into this country.

RAILWAY WORK.

Railway Progress in Yorkshire. — The first sod of the new line which will connect the Hull and Barnsley railway system with additional South Yorkshire collieries, has just been duly "turned." The growth of the coal traffic of the Hull and Barnsley Railway is evidenced by the fact that several miles of sidings constructed at Spring Head, about four miles from the Hull Alexandra Dock, are now nearly fully occupied with coal trucks. The new line will be about nine miles in length, commencing at Wrangbrook, and terminating at Wath-upon-Dearne. It will pass through Elmsall, Hooton Pagnell, Thurnscoe, and Bolton-upon-Dearne. The collieries it will serve are Hickleton Main, Wath Main, and Manders Main, which are among the largest in South Yorkshire. A large pit is also about to be sunk at Frickley, which will be connected with the line. These collieries will find increased work for new coal shipping appliances, which are about to be set up at the Alexandra Dock.

Great Railway Developments in the United States.—The railway developments on the other side of the Atlantic proceed with leaps and bounds. The addition of new lines to the railway system in the United States during the first half of the current year is estimated to be 1181 miles, an increase of 90 miles over the figures for the corresponding period last year. The total is distributed among 110 companies, making the average for each company less than 11 miles.

The longest addition completed by any one company was sixty-four miles (Illinois Central), while the five leading lines aggregated only 244 miles, or less than 50 miles each.

The New Midland Railway Locomotives.—It appears that the ten locomotives which are now being constructed at the celebrated Schenectady Locomotive Works for the Midland Railway will vary somewhat considerably from those completed for the same road at the Baldwin Works. Both in construction and appearance there are points of difference. The weight of the Schenectady engines is 107,000 lb. each, of which 89,000 lb. are on the driving wheels. The driving wheels are 60 ins. in diameter, of cast steel. The tender is carried on six wheels. The weight is 43,800 lb. and the capacity 3,250 gals. of water and six long tons of coal.

Cast-welded Rail Joints.—Rail joints made on cast-welded principles are attracting a good deal of attention in America at the present time. As laid down in the streets of Milwaukee, the standard rail is a 6-inch 72 lb. tee rail in 60 ft. lengths and laid on oak ties, 6 ins. × 8 ins. × 7 ft. About two years ago the Falk Company made some experiments on track so poor that without them reconstruction would have been needful. In the two years this track has worn to a better surface, and it is estimated that five or six years additional life has been given to the rail by the cast joints. By the end of this year all the joints in the city limits, some 40,000 in number, will be cast-welded. A similar process to the Falk process is that of the Milwaukee Rail Joint and Welding Company. This Company places a jacket round the joint and pours inside this jacket, which remains in position after the clamps are removed. A slip joint is provided every 500 feet to allow for movement which amounts to about 1¼ in. per 100 feet of track, an amount, no doubt, much in excess of anything likely to occur in England. Another method of electrically welding rail joints is one in which the weld is made from a boss on a bar or fish plate, and not direct upon the flat of the bar. The system is stated to be perfect as a rail joint, and as a bond for rail returns it reduces electrolysis to a minimum. It is stated that even with a stress of 350,000 lbs., a weld thus made has not been sheared off, and no breaks have occurred except in very cold weather.

MINING.

Important Work at the Cumberland Iron Mines.—We understand that the construction of a massive sea embankment is contemplated, in order to keep the sea from encroaching upon the workings of the Hodbarrow iron mines in the south of Cumberland. Some ten years since, nearly £200,000 was expended in building a sea wall for the same purpose. It is now proposed to go further seawards. The new wall will be in the form of an embankment with a puddled trench, and with rough squares of concrete tumbled down the bank as a breakwater. This new embankment will be 6750 yards long, and will enclose a large area of land, under which a new extension of the mine will be worked. Ore has been proved to exist in vast deposits under this area, and although the cost of the proposed scheme will probably be from £400,000 to £500,000, it is expected that a good return will be realised.

Iron Ore in Cornwall.—"Fish, tin, and copper" has long been the industrial motto of Cornwall, and while tin and copper mining operations are none too brisk in "West Barbary" at the present time, it is satisfactory to learn that the stimulus recently given to the search for new sources of supply of iron-ore, by its scarcity and the recent advances in prices, appears to have led to a measure of practical success in Cornwall. At Blisland, about five miles north of Bodmin, trial shafts have been sunk, and ore obtained which proves to be a red hematite, containing over 50 per cent. of iron and 0·03 per cent. of phosphorus, with 0·07 per cent. of sulphur. It is estimated that this ore can be delivered at tidewater at Wadebridge, on the Padstow estuary, about 12 miles by rail from Blisland, at from 5*s.* to 6*s.* per ton. Judging from the analysis, it is concluded that this ore compares favourably with the South of Spain hematite, which is worth at Carthagena 6*s.* 11*d.* per ton. Of the quantity available at Blisland it is estimated that there may be 2,000,000 tons—much less than one-half of the annual import into this country from Spain.

Mining in British Colombia.—There is much that is suggestive of the mining future of our vigorous Western Colony in the annual report of the Minister of Mines for British Colombia for last year. It affords an index to the extensive area covered by mineral deposits, and to the increased activity of the mine-owner and prospector. A series of statistical tables shows the rapid increase of mineral production, the total for 1898 being 10,906,861 dols., comprised mainly of gold, silver, lead, and coal, whilst the output of copper has made a very large advance. Of gold, the lode mines yielded 110,061 oz., and the placer 32,167 oz. Last year was in many respects one of development, as, pending the completion of the new branch line of the Canadian Pacific, which brings coal and coke from the Rockies into the heart of the Kootenay country, many of the mine-owners temporarily ceased shipping.

British Imports of Iron Ore.—It is worthy of more than passing notice that the imports of iron ore into this country continue to total up to an unprecedentedly large aggregate. The total quantity imported to the end of the half-year ended June 30 is 3,638,508 tons, which is an increase of about 700,000 tons—equal to some

35,000 tons of pig iron—on the imports for the corresponding period of 1898. All but a small part of this increase has been received from Spain, the whole imports from other sources only amounting to 435,629 tons. If the same relative rate of ore import is maintained in the latter half of the year, the additional quantity of ore imported in 1889 over 1898 would be equal to an increased production of some 700,000 tons of pig.

Mining in Borneo.—According to the report just issued of Mr. Consul Keyser on the trade of Borneo and Sarawak for last year, the coal mines of Sadong, which belong to the Government, have a nominal output of about 130 tons per day, which, it is anticipated, will shortly increase to 5,000 tons per month. This coal is sold in Kuching for 8 dol. 50 c. per ton. In Singapore it fetches 8 to 9 dol. per ton. At the Brooketon mines belonging to Government the output is about 40 tons per day, which should increase with improved management. Gold is worked by Chinese in Upper Sarawak from alluvial deposits. The Borneo Company, Limited, have erected very large cyanide works at Bau for the treatment of low grade ores. All these works have proved a success, and another factory is in course of construction at Bidi, a distance of four miles from Bau. Antimony is also worked by the Borneo Company in Upper Sarawak. Mineral oil has been found at Mori near Baram, and this will shortly be properly tested. Diamonds are only found in very small quantities, and rarely of any size. The Borneo Company, Limited, hold a concession for all minerals excepting gold, coal, and precious stones, between Gampong Datu and Kedurong. Beyond these limits the country is open to prospectors. The only method of working gold which has been found to be paying to Europeans is by the cyanide process, the ore obtained hitherto not being rich enough for crushing with stamps to give adequate returns. The only concessions given so far to work for gold are to the Borneo Company and the Borneo Mineral Company.

The Mineral Resources of Venezuela.—In his recent report to the Foreign Office, Mr. W. H. D. Haggard, H.M.'s Minister at Caracas, in an exhaustive report on the trade and commerce of Venezuela, draws special attention to the mineral wealth of the country, which, like its vegetable and animal resources, is as yet practically untouched and apparently inexhaustible. There is hardly a mineral which is not found: iron, coal, petroleum, gold, silver, copper, lead, &c., are found in every direction. The working of these mines ought, under improved conditions, among which may be mentioned those of land traffic and transit, to add greatly to the wealth of the country, and even of the world. Venezuela is already provided by nature with a magnificent water system in its rivers, and when once these great natural arteries are supplemented by feeders in the form of roads, a new era of prosperity, the Minister declares, should dawn for the country. One of the most noticeable sources of mineral wealth at this moment lying waste is that of the asphalt lakes, apparently forming part of the same system in which is included the famous pitch lake in the neighbouring island of Trinidad. This vast and inexhaustible supply of wealth is practically untouched.

The Canadian Iron Mines.—We had something to report last month as to the development of the iron ore deposits of Canada, and it is satisfactory now to learn from a Duluth, Minn., U.S.A., despatch, that the first active steps ever taken on any considerable scale for the exploitation of the iron ore mines of far Western Ontario have just been made. Lands on the Atikokan range, west from Lake Superior, and north of the international boundary, and belonging to the McKellars, of Fort William, have been taken, and 10,000 dols. paid down for an exploratory option. These lands cover six miles of an outcrop on the range, and iron men who made an examination for the buyers state that there are no such enormous outcrops of good ore in the known world. Development will be undertaken at once to ascertain the extent of the deposits. The deal is reported to be the most important iron ore purchase ever made in the Dominion. The ores are magnetic, and are very high in iron, and contain almost no phosphorus. The only cause for regret is that it is American, and not British capital, which is at the back of the enterprise.

The Cornish Tin Mining Industry.—It has long been the fashion amongst an extensive class of mining men and investors in mines to decry the future paying possibilities of the tin mines of Cornwall. Certainly there has been good ground for much of this criticism, but the abnormal price of tin is probably at the bottom of it all. There is much truth in what one writer recently stated in one of the financial dailies. "One can but feel certain," he says, "that had Dolcoath, West Kitty, and other [Cornish] tin mines been in the region of the North Pole or some other outlandish place, they would have received more of the attention of the knowing speculators, as a cablegram once a month and a twelve months' report would place things before their clear vision in such a light that the price of these shares would stand at something like their real value. The price of tin has not been so high for fifteen years by £50 per ton, and these mines have given dividends during the long depression. What, then, I ask, can they do now, with tin £140 per ton? Speculators and investors will do well to ponder this, and look at home."

Sulphur Deposits in Spain.—The sulphur mines of Sicily, the most extensive and valuable in the world, are having their supremacy threatened from various parts of the world. Letting alone the latent sulphur discoveries in North and South America, the sulphur mines of Spain are beginning to attract attention, especially in America. These

mines—or those of them which are so far exploited—are the Sierra Gador, which are situated near the port of Almeria. The formation in which the native sulphur occurs may be classed as middle eocene, composed of coarse-grained limestone, limestone conglomerate, and clay marls. The sulphur has permeated all these strata. In the limestone it occurs in the joints and cavities, associated with gypsum in large masses; in the conglomerate it occurs as a cement, binding the rounded pebbles together; and in the marls the sulphur is present as innumerable veins. Between the marls and conglomerates in many places there is found a band varying in thickness of almost pure sulphur assaying probably 90 per cent., the ordinary yellow sulphur alternating with narrow parallel ribbons of black sulphur. So far as proved, the sulphur-bearing zone at Gador measures about 1,300 feet in length by about 400 feet in width and 160 feet in depth. The average sulphur contents may be reckoned at 15 per cent. The deposit has been attacked by a number of shafts and levels, but no uniform method or system of working has, it is reported, been followed. This last statement will perhaps afford one crumb of consolation to the friends of the Sicilian properties, the more nervous among whom, we hear, do not relish the growing cosmopolitan-like production of sulphur.

Soap and Paint Mines in British Columbia.—A natural soap mine and a paint mine are two of the latest mineral curiosities discovered in British Columbia. Several soda lakes have been found in the foothills near Ashcroft, B.C. Their bottoms and shores are encrusted with a natural washing compound, containing borax and soda. No two analyses agree exactly as to the composition of the material. A New York analysis gives 26 per cent. borax, while a Montreal chemist, from the same sample, gives 16 per cent. borax. Tests prove the substance to be equal to the washing powders in common use for cleansing purposes. Trials by blacksmiths and farm workmen show, it appears, that it will remove grease and dirt quicker than soap. After many such tests a syndicate of British Columbia men has been formed to put the product on the market. About 275 tons of the compound have been cut and taken out of one lake. It is handled precisely as ice is handled. The blocks are more than 9 in. in thickness, are sawed in blocks 15 × 18 ins., and weigh 50 lb. each. It is estimated that this lake alone contains 20,000 tons, proving that the industry, if successful, will reach large proportions.

PAPER and PRINTING INDUSTRIES.

American Printing Machinery in Great Britain.—Although in a general sort of way it is known that American printing machinery is rapidly extending its field of operations in this country, it will surprise many to learn the rapidity with which Hoe machines, for example, are being introduced in our newspaper offices. The London branch of Messrs. R. Hoe & Co. has recently received an order from the proprietors of the *Scotsman*, Edinburgh, for two quadruple machines and two four-roll presses. Each of these machines will be capable of producing four, six, or eight-page papers at the rate of 48,000 per hour; ten, twelve, fourteen, or sixteen-page papers, all inset, at 24,000 per hour, and twenty or twenty-four-page papers at 12,000 per hour. The firm has also received orders from the *Birmingham Daily Post* for one of their four-roll machines; from the *Hull Daily Mail* for a quadruple press; and one three-roll machine for the *Adelaide Observer*. Each of these machines is capable of producing four, six, eight, ten, and twelve-page papers, all inset, at 24,000 per hour, and sixteen, twenty, or twenty-four-page papers at 12,000 per hour. There is also on order one two-roll machine for the *Southern Echo and Hampshire Advertiser*, Southampton. At the present time there are in course of construction in the London works of the Hoe Company the following list of presses:—Four quadruple machines for the *Daily Mail*, London; two quadruple machines for the *Scotsman*, Edinburgh; one quadruple machine for the *Daily Mail*, Hull; two four-roll machines for the *Sporting Chronicle*, Manchester; two four-roll machines for the *Scotsman*, Edinburgh; one four-roll machine for the *Yorkshire Post*, Leeds; one four-roll machine for the *Aberdeen Free Press;* three four-roll machines for the *News of the World*, London; one four-roll machine for the *Birmingham Post;* one three-roll machine for the *Nottingham Guardian;* one three-roll machine for the *Adelaide Advertiser*; one two-roll machine for the *Southern Echo*, Southampton; one single-roll machine for the *Daily Mail*, London; one single-roll machine for the *North British Daily Mail*, Glasgow; and two single-roll machines for the *Harmsworth Magazine*, London. This list is instructive in a twofold sense, showing not only how much our American competitors are gaining in this country, but how much our British printing machinists are losing.

The "New Sun Process" for the production of tracings, estate plans, perspectives, contract drawings, and the like, invented by Mr. Albert E. Mallandain, of 51, Cheapside, London, E.C., has come under our notice. The copies obtained by this process are identical to the originals, and the results resemble those taken by lithographic methods. A specimen before us, copied on "Whatman's" drawing-paper direct from a tracing, gives very clear definition, and an altogether excellent black and white result. Copies can also be produced on thick linen, mounted paper, or cartridge paper. In preparing the originals, the use of proper ink is essential to secure effective reproductions, but if the instructions which Mr. Mallandain gives are carefully followed, there is no risk, seemingly, of failure.

TEXTILE INDUSTRIES.

Prosperity in the Lancashire Weaving Trade.—In well informed quarters it is considered that the weaving trade of Lancashire is more prosperous now than has been the case for five or six years. It is said that whilst prone to indulging in pessimistic forebodings, not a few manufacturers in the South-East Lancashire area are now inclined to take a more optimistic view of the situation than they have done for a long time past. It is computed that there are at least 10,000 more looms working full time now in the Burnley, Nelson, Colne, Blackburn, Bolton, Westhoughton, Farnworth, Ashton, Stalybridge, Droylsden, and Hurst districts than was the case at the beginning of 1899, and the number is being added to almost daily. At Hurst, near Ashton-under-Lyne, in one shed alone no less than 600 Jacquard looms for the weaving of fancy goods are being put down; at Westhoughton, near Bolton, 400 looms for grey cloths have just been started, and similar developments have been, and are, taking place in almost a score of other Lancashire districts. All of these facts are matters for congratulation.

Improvements in Jacquards.—Although the best types of modern Jacquards by no means represent finality, few improvements of material consequence and practical value have latterly been introduced in this class of machine. Two improvements in details have, however, been recently introduced which indicate that textile machinists yet see scope in the Jacquard for sensible modifications. In one case a double machine is used for weaving alternative designs. Its maker is Mr. H. Schroers, of Crefeld, who arranges two cylinders for the Jacquard, one carrying the groundwork design and the other the border pattern. The patterns are changed by means of a chain of metal lags working in connection with an extra hook in the Jacquard. The cylinders are suspended from lathes, and swing in their guides against needle-boards. Hooks are provided with double catch hooks made of flexible metal, each hook governing two needles which work in different directions—that is, one needle works against the left cylinder, whilst the other works against the right. Above the needles is a rack, which is the main feature of the improved machine, and which can be moved in a lateral direction as desired. The sum total of these and other arrangements is that the machine may be kept working with one set of pattern cards as long as required, the other set remaining at rest. In another Jacquard, which has been introduced by Mr. L. A. Garchey, of Paris, the machine works without a needle case or spring needle guides. It has additional parts which impart different movements to the cylinder, needleplate, etc., in a very exact manner, in order to protect the cards. It is also fitted with a contact appliance which makes it possible to easily put any number of rows of needles out of gear without exposing the rest of the wires to any risk of injury.

New Type of Decorticating Machine.—Although there are quite a number of different types of decorticating machines before the textile world, the form which appears to be meeting with most acceptance in the decortication of textile plants is the one whose main features consist of a beater drum and a bed or breast. The stalks are passed between these two, becoming broken and eventually being thrown out by the beater, the fibres descending vertically on leaving the bed. In order that these fibres should be in as free a state as possible, a return movement is usually given, either by hand control or automatic mechanism. A new machine by a Viennese inventor provides a new method of effecting this return movement, which appears to commend itself to those who have examined it in operation.

New Wool-shearing Machine. — Sheep-shearing machines are not now-a-days specially uncommon, but a new mechanical apparatus has been devised for shearing the wool from the mutton—at all events from the carcases of sheep which have been killed unshorn. The process in general use is the steeping of the skin and wool in lime water, or the sweating of the skins by steaming them and piling them one upon another, thus inducing an incipient stage of decomposition. In both instances the wool is pulled from the skin by hand, and the process is obviously a most offensive one. Moreover, both wool and skin suffer to some slight extent in quality, and especially in the case of limed skins the wool is deteriorated. The new apparatus is an electric cautery, or fleshing knife, in such a handy form that the wool may be shorn or cut from the skin rapidly, and without injury either to the wool or to the pelt. The form of the cautery is somewhat like that of a horse-clipping machine—a handle connected by flexible cables with the electrical supply, and a head composed of a thin sheet of metal amalgam, which, under the influence of the electric current, rapidly develops to a bright red or golden yellow heat, like the filament of an electric lamp. The metal is clamped into a non-conducting refractory arch of very hard fireclay, only a very small portion of the metal, or cutting edge, being thus exposed. The method of removing the wool is simply to push the cautery along the surface of the skin.

New Process for Producing Stripes on Fabrics.—It is much to be desired that some method of simplifying the production of coloured stripes on fabrics might be made available; a new process is now being tried which, if successful, should do much towards the removal of the present difficulty. In the new system instead of printing the cloth as is at present the universal method, the colouring matter or chemical agent is applied to the fabric by means of tubes the exits of which discharge the colour on to the fabric as it passes them in a longitudinal direction. The tubes are in communication with suitably arranged receptacles for multiple colouring, or may be all attached to

a general one if only one colour is to be applied. The size or shape of the ends of the colour tubes are varied according to the size of stripe or similar effect which it is desired to produce, and the tubes are fitted with adjustable springs to keep them in proper contact with the fabric under treatment. In some cases the colour tubes are movable, so that as the cloth passes in a longitudinal direction specially-arranged cams or cranks impart a transverse motion to the colour tubes and so produce zig-zag or wavy effects upon the fabric.

MISCELLANEOUS.

A New German Industry.—Sir Charles Oppenheimer, our Consul-General at Frankfort-on-Main, in his last report to the Foreign Office, remarks that while attempts are being made in Germany to artificially exclude foreign competition, the Germans themselves are successfully endeavouring to profit by the industrial progress made by foreign countries. Recently special engineers have been sent over to America to study the methods in vogue there. A result of the study of American progress is the establishment of a German chromo-leather industry. It is true the Germans claim to have themselves invented the manufacture of leather with the use of chrome salts, and Dr. C. Heinzerling, of Frankfort-on-the Main, is named as the inventor of this process, which in the year 1884 was finished by Schulz in America for technical use. A new factory has been furnished with American tanning machinery which is capable of turning out daily 500 dozen goatskins, and it is contemplated to raise the output to 1,000 dozen per day. The success has created great rejoicing in Germany.

We are pleased to learn that the well-known machinery business, conducted by Mr. Charles D. Phillips, M.I.M.E., for so many years at Emlyn Works, Newport, Mon., continues to prosper. Mr. Phillips has now removed his agricultural department to his Clarence Place Depot, Newport, where an extensive stock will be maintained. Mr. Phillips has also an establishment at Gloucester.

A New Roofing and Flooring Material has been invented by Mr. Gehre, who was the nventor also of papyrolith, over which the newer material is said to present advantages. Papyrisette, as it is called, can be adapted for various purposes, but it is specially intended to serve as a solid, impermeable, and jointless roof, or floor, which, when laid down, will present a smooth surface, as if made in one continuous layer. It is claimed to be absolutely fireproof, and a non-conductor of cold or sound, and although as hard as stone, it has a soft linoleum-like feeling to the foot, and is noiseless. As there are no grooves or joints in the material, no dust, vermin, or fungi can accumulate, and its weight is much less than that of stone or cement. Two hundred and twenty pounds of this preparation in a powdered form, when mixed for use and spread to a thickness of 0·3940 inch, will cover a surface of 91½ square feet. Moreover, it can be cut, sawn, and bored, can be given any desired tint, and can be made to look like mosaic or marble. The inventor has constructed a light iron frame, on which the material can be laid, in the form partly of plates and partly of mortar, which, when united, produce a smooth, continuous surface for roofing purposes. It is adapted to cold as well as tropical regions, and its stone-like qualities prevent it from being destroyed by mice or other vermin. The material will not contract or warp after having been laid down, and it is elastic, light and inexpensive.

New Laundry Specific.—A new antiseptic is described in one of the laundry trade journals. It is intended to sterilize clothes when being laundered, thereby preventing contagion from germ diseases. It is known as a solidified Formaldehyde and generator, and is the product of Dr. Geo. Leininger. Formaldehyde is made from wood alcohol by a scientific process, and has for several years been known to the medical profession as a liquid concentration. Numerous experiments, it is claimed by Dr. Leininger, have proved that Formaldehyde positively renders the growth or extension of anthrax cholera, typhoid and diphtheria bacilli or similar germs an impossibility. By a process originally discovered by the doctor, this Formaldehyde solution is solidified and all the impurities which it might contain eliminated, making it a most effective and economical disinfectant and antiseptic. The theory or fact is advanced by scientific investigators that zymotic diseases, such as diphtheria, small pox, typhoid and yellow fevers, are often distributed through the public laundries. This, it is claimed by Dr. Leininger, can be absolutely prevented if this antiseptic is used by laundrymen.

British Exports to Damascus.—Although Damascus is described by Mr. Consul Richards, in his report for last year just issued, as "not really a commercial city at all—it is rather to be described as an industrial and agricultural centre . . ." still this country has hitherto done a large trade with the district, and holds its own in some, though not in all departments. The Consul's report states that in iron we are losing ground, Sweden and Belgium, but more especially the former, doing a larger business. Copper, it seems, is entirely supplied by us to the extent of about 85 tons per annum, which is rather less than in former years. There is now a tendency, which is becoming every year more marked, to employ iron enamelled ware, which is mostly supplied by Germany. Brass, of which there is a yearly increasing importation, comes in almost equal proportions from Belgium, France and Germany. Of zinc, tin and lead, about 60 per cent. is supplied by England; and here again, in tin plates especially, the demand is growing less every year. Zinc, imported in sheets, comes nearly entirely

from Belgium, and bar tin, wholly from England, holds its ground. In hardware, Germany, Austria, and, in a much less degree, France, furnish the principal portion of this class of goods, England's share being confined to such articles as dished sheets, iron bedsteads of the very commonest and cheapest description, blue tacks, and a few other goods, making up, altogether, about 15 per cent. of the whole hardware importation. Germany is gaining ground greatly, all tools, to mention only one class of article among many, being now supplied by her. *Verb. sap.*

Milling Plant in the Philippine Islands.—In consequence of the unsettled state of affairs in these islands, it is hardly surprising to find that the report of Mr. Consul Harford for last year, just issued, is somewhat incomplete and inconclusive. He states, however, that notwithstanding that for the moment all commercial enterprise is paralysed, there is abundant evidence that when peace and a settled form of government are well established, the future prosperity of the Filipinos will far exceed the past. On the subject of the import machinery trade, of which we have held a fair share hitherto, although America may be expected to step in determinedly here, the Consul reports that: "On account of the unsettled state of affairs in the whole group of the Philippine Islands, the sale of new milling plant has been almost nothing; and until matters are arranged definitely, and planters recover from the severe strain of the revolution, I see no hope of this branch of import."

New Patent Law of Austria-Hungary.—Like other nations Austria-Hungary has found it necessary, in the interests of industrial and economic progress, to revise her patent laws, and in his report on the foreign trade of that country for last year, Mr. Consul-General Paul von Schoeller states that the new law, which came into force at the beginning of the year, differs in various essential respects from the prescriptions which have hitherto regulated the issue of Austria-Hungarian patent rights. Formerly a patent was granted on every invention for which a claim was put in, and it was left to those who deemed themselves injured by the granting of patent privileges to seek legal redress. According to the new law, an invention for which letters patent are claimed has to be passed by an examining board composed of lawyers and technical experts. In the event of the invention being really new it is advertised in a journal published by the Austrian Patent Office, and in addition the plans and drawings relative to it are open to public inspection for the space of two months. The new law also stipulates that every foreigner resident abroad applying for a patent must do so through the medium of a representative resident in Austria. This representative must be duly provided with a power-of-attorney authorising him to act on behalf of the foreign applicant, which he must present to the authorities, and which, together with his name and address, will be officially registered in books of the Patent Office.

Mr. Robert A. Hadfield, the distinguished metallurgist, and chairman and managing director of Hadfield's Steel Foundry Company, has been elected, at Sheffield, Master Cutler for the ensuing year.

The Cape Asbestos Company, Ltd. have again distinguished themselves in competition, by having been awarded a gold medal diploma of merit at the Greater Britain Exhibition for the excellence of their exhibits in blue asbestos coverings for the boilers of locomotive engines and steamships.

Cream Separators: a Correction.—In a paragraph in our "Industrial Progress" pages last month reference was made to an improvement in cream separators of the Alpha-Laval type. We remarked that "up to the present time, in cream separators the inflowing milk has usually passed into the bowl near the centre, and has had to make its way through the wall of cream, which is driven by the centrifugal force near to the centre of the revolving bowl." Messrs. Watson, Laidlaw & Co., of Glasgow, inform us that this statement is inaccurate inasmuch as their Mr. John Laidlaw in 1892 patented certain "improvements in centrifugal machines for separating fluids of different densities." In the specification of this patent, which is now before us, arrangements are described and illustrated, by means of which a method is arrived at for introducing the whole milk between the wall of cream and the wall of skim milk, so that neither is disturbed. We much regret that we have been led inadvertently, from erroneous information which we had reason to believe was trustworthy, to give publicity to any statement which did not accurately represent the facts of the case with which we had to deal.

Another New Acetylene Gas Generator has just made its public *début*. Husson's patent generator plant, as it presented itself at a demonstration the other day, consisted of a small gasometer, and a generator, not unlike a gasometer in shape, the two being connected with tubing. The generator had been filled with water, visible in an oblong box-like aperture at the top. Into the water through this aperture the carbide was dropped, the water fizzed a little, and it was explained that the generation of acetylene gas was taking place, the gas (prevented by water from escaping) being forced through the tubing into the gasometer. To the latter another tube, with a burner, was attached, so that the light which the gas afforded might be seen. The light from the burner was a pure white flame of considerable power, yet soft, cool, and pleasant to the eye. The inventor claimed that the light produced was cheaper than coal gas, that its illuminating value was much greater, and that it consumed very little oxygen.

BRITISH.

A PRINCIPAL feature of recent numbers of **The Engineer** has been the serial article on "Automatic Couplers on American Freight Cars," by a special commissioner of that journal, who deals exhaustively with the historical and mechanical aspect of his subject. In the issue for the 14th July there is a useful practical article on "Paints for Iron," with valuable formulæ. In the same number a further illustrated instalment of the article descriptive of the Works of the Diamond Match Co., Ltd., appears, as do also articles on "Electricity in Steel Works," and leaders on the Irish Channel Tunnel scheme, and the London and North-Western Railway Co.'s four-cylinder compound engine, the "Iron Duke." On the tunnel scheme, with especial reference to the recent deputation to Mr. Balfour, *The Engineer* says:

> Lord Charles Beresford has been credited with saying that so long as money enough was forthcoming engineers could do anything. We fear that he has formed rather an exaggerated estimate of our powers. We are quite unable, at all events, to say whether the proposed tunnel could or could not be made, simply because no positive information on almost important point is available. No one knows what faults exist in the bottom of the Channel. It is proposed that a railway shall pass 150 ft. below the sea bottom. No borings have been made in mid-channel. The whole region manifests signs of violent volcanic action. The construction of the tunnel would be commenced absolutely in the dark as to the condition of the strata to be passed through; how far it is fissured, how far saturated, no one has any accurate information. We take it for granted that Lord Londonderry, Mr. Barton, Lord Charles Beresford and others associated with them, are quite serious. But if they are, why did they not come to Mr. Balfour prepared with some information? They might have had at least a few statistics of value as to the probable traffic. If the deputation came determined to disarm criticism by reason of the exceeding paucity of information supplied, they have no doubt succeeded; but, on the other hand, they have also succeeded in reducing their proposals to the well-known category of wild-cat schemes; of which, indeed, this really seems to be one of the finest and wildest.

In *The Engineer* of the 28th July, Mr. Rous-Marten has an interesting contribution on the British and French summer train services, in the course of which the best English runs do not compare favourably with the best of our neighbour's, which are described as "French marvels." In the same issue the subjects dealt with include "Gas Tram Cars," the new battleship *Vengeance*, and the recent addition to the Thames' resources in graving docks, while the leaders have for their subjects "The Cornish Engine," described as "one of the most remarkable heat engines ever produced," and "Water-tube Boilers in the Navy," the latter suggested by the recent attack upon the water-tube generator in the House of Commons. In the course of the latter article *The Engineer* says:

> Steam machinery is no respecter of admirals. It does not know or care for whom it is working; and it is tolerably safe to say that if any device or combination of mechanism will not answer in Atlantic liners, neither will it be used without trouble in the Navy. If the water-tube boiler is not worked at high pressure, one of the principal arguments in its favour disappears. The whole history of the movement is plain. The Scotch boiler was not a success in the Navy because it did not get fair play. It was expected to do things of which it was not capable. At no time a boiler well adapted for forcing, it was not only forced, but as badly designed to suit forcing conditions as possible. It broke down under the strain, and the Belleville boiler was put into the Navy in its stead. . . . . We have got high pressure and the Belleville boiler for the present, and the British Navy would be better without them. But they have come to stay for some time, and to discuss their merits or demerits in the House of Commons is but waste of energy.

An article on the six-coupled express engines for the North-Eastern Railway, from the pen of Mr. Charles Rous-Marten, has a prominent place in *The Engineer* of the 21st July, in which also appear illustrated accounts of the engines of H.M. destroyers *Mermaid* and *Cheerful*, and a copiously illustrated paper read by Mr. A. Y. Yarrow before the Institution of Naval Architects on "Some Experiments having Reference to the Durability of Water-tube Boilers"—a subject of topical interest at the moment. A leading article deals with United States competition in the light of a letter written by Mr. Moreton Frewen to *The Times*. The question of trusts is necessarily involved therein, but the view taken is by no means pessimistic:

> The more carefully we consider the present movement in the United States, the less reason, it appears to us, is there for apprehension. What advantages are supposed to flow from the combination of all the steel makers, let us say, of the United States? The answer given is two-fold. In the first place, it is stated that it will prevent "cutting" prices in the steel trade. In other words, it will put an end to competition, and leave the consumer absolutely at the mercy of the steel ring. Whether this is or is not likely to develop demand, our readers must judge for themselves. Secondly, we are assured that the concentration of interests and the abundance of capital will stimulate invention and reduce the cost of production. But nothing does more to stimulate invention and lead to improvement than healthy competition. A ring is the last body of men on earth from which we should expect improvements of any kind to emanate. Lastly, it is argued that the production will be so enormous under the new management, and the sums required to pay dividends so large, that sales must be made, if not at a high price, then at some lower price. That, in one word, the world will benefit by the ring in spite of the ring. The answer is simply that rings are by no means new. We have had great trusts, and rings, and corners before now, and it would pass the wit of

man to prove that the world has been the better of any of them. Mr. Frewen does not cast a doubt on the honesty of purpose of the great trusts, yet even so he does not write of them as though they were a menace to this country. Threatened men live long, says the old adage. British trade is not dead yet, and we venture to think that, as regards the United States, the situation is improving.

The various works and shipyards visited by the members of the Institution of Naval Architects during their meeting in the North of England are described in *The Engineer* of Aug. 4th, as are also the experimental model basin at Washington; a new pig-iron casting machine, designed by Mr. Wm. Hawdon of Middlesbrough—a development of the same gentleman's well-known device for dealing with blast furnace slag; the Camborne Mining School, which has done such excellent educative service to rising generations of mining engineers; and the recent motor wagon trials at Liverpool. In an appreciative leader dealing with the Institution of Mechanical Engineers, which has just had a noteworthy meeting at Plymouth, the reading and discussion of "papers" come in for some criticism, of which the following passage may be quoted:

> A practice has grown up, which we have already censured many times, of wasting time in more or less fulsome praise of the writers of papers. We have heard a speaker hold forth for five minutes on the transcendent merits of some contribution, and then when his hearers expected he was going to open his own storehouse of information and impart to the meeting, end with the statement that he had nothing to add, and so sat down. It is not too much to say that any man who is competent to pronounce an opinion worth having concerning the merits of a paper must know enough to enable him to take a useful part in discussing it. If he really has nothing to contribute himself, then it may be taken for granted that he does not know whether the paper is a good paper or not. The passing of a vote of thanks to a reader ought to be regarded as satisfying all the demands of courtesy.

A good deal of space in the above-mentioned issues of *The Engineer* is devoted to reports, in most cases illustrated, of papers read at the recent meetings of the Institution of Naval Architects and the Institution of Mechanical Engineers.

In **Engineering** for July 21st prominence is given to an illustrated article descriptive of the Plymouth Electric Supply Works, recently visited by the members of the Institution of Civil Engineers during the period of their meeting in the western town. The engineering aspects of the late Spanish-American war are again dealt with in an article which treats especially with the effects of the gunfire on the vessels engaged in the naval operations. In the same number a further instalment of the illustrated serial description of the Westinghouse Electric Works at Pittsburg appears, as do also another portion of the description of the Alexander III. Bridge at Paris, with detail drawings; a report of the Automobile Exhibition in the same city; and another of the meeting of the Institution of Naval Architects at Newcastle-on-Tyne. In a leading article on "The Engine Room Staff" the grievances of the naval engineers and artificers are reviewed, and the conclusion emphasized that "to supersede the mechanic by a half-trained man would be as dangerous a policy in its way as substituting imperfectly trained executive officers for competent engineers." We should mention, also, an article on the "Parole" water-tube boiler.

In *Engineering* for the 28th July the Newcastle meeting of the Institution of Naval Architects again comes in for prominent notice. Messrs. H. T. Parshall and H. M. Hobarts' serial article on "Electric Generators" is continued, and a further instalment of the copiously illustrated article on the Schneider works at Creusot is given. A pictorial supplement illustrates a new bridge to span the Indus, constructed by the Thames Iron Works and Shipbuilding Co., Ltd. for the Kotri Rohri section of the Indian State Railway. The recent parliamentary debate on water tube boilers in Her Majesty's ships is dealt with in a leader, which handles Mr. William Allan, the member for Gateshead, somewhat severely. *Engineering* insists that the debate proved:—

> That the opponents of the water-tube boiler are becoming fewer and feebler as experience grows with this form of generator; and our contention has always been, that, given fair play, and an efficient staff to see its manifold requirements, the water-tube boiler in some form, not necessarily the Belleville, is the only type of steam generator fulfilling all the conditions which the naval tactician demands. We fully admit that it requires great skill and care on the part of the engineers and stokers, and that life in a stokehold fitted with such boilers is much more onerous than in that of an Atlantic liner. Possibly, the water-tube boiler will cost more for repairs, although this is a moot point, when we remember that it can be renewed without cutting the decks. Certainly, as an apparatus for evaporating water, few engineers would choose to use it. But it must be remembered that a boiler on a Navy ship has to be looked upon as a weapon of war, and not as a thermodynamic device. Its object is to aid in the destruction of the enemy, and the boiler which offers the greatest advantage in this respect is the one to use. If a tube-boiler will enable the admiral to start the chase two hours earlier than he otherwise could, and if it will give him one or two knots more speed, then its use is fully justified, even if it be costly to buy and require great care in its use. The cry against it is only a repetition of the opposition offered to all improvements in *matériel*.

Engineering of the 4th August deals further with the Automobile Exhibition at Paris, the Westinghouse Works at Pittsburg, and the model tank at the Washington navy yard. Mr. Yarrow's paper on the durability of water-tube boilers is continued. Eight other papers read at the meeting of the Institution of Naval Architects make up an excellent number. The leading article deals with the question: "Why are some warships built in England for foreign Powers so superior to our own Admiralty-designed ships in certain defensive and offensive qualities?" *Engineering* urges the necessity for the policy of the "free hand" for the responsible naval architect, and adds:—

> When Sir William White has a ship to design he has a hundred and one persons who have much to say in the matter. If he attempt to leave anything out that is obsolete, or, at any rate, which might be omitted with advantage for other features, there is sure to be an admiral or a captain (if not half a dozen) to think himself defrauded, and who will raise the question before the other admirals who form the Board of Admiralty. Naturally naval men must be the final

> authorities as to what is needed in a warship, but at present there are too many fingers in the pie—too many cooks to spoil the broth by insisting on their own particular seasoning. No better instance of this could be given than that of the old "torpedo-boat catchers," as they were called until the absurdity of the name was made manifest by their inability to catch anything. They were designed at Whitehall under all the trammels of red tape. . . . There a change in procedure was tried, and the torpedo-boat builders were given the "free hand"—tempered by inspection—and the entirely successful torpedo-boat destroyers were evolved.

One of the most interesting articles in **The Mining Journal** of August 5th is one by Mr. S. J. Truscott, A.R.S.M., F.G.S., which deals with the little-known position of Gold Mining in the Dutch East Colonies. "The whole gold mining industry in these Dutch East Indies," says the writer, "is now on a most satisfactory footing, which is chiefly due to the broadmindedness of those who have the direction in their hands, and these men are content to await the advance, because they are confident." The first of a series of articles on "Hydraulic Sluices," by Captain C. C. Longridge, deals with the construction of these contrivances, and the initial instalment of a serial contribution on the Lucknow Gold Field, New South Wales, also appears. Cuban Minerals is the principal leader in a very "solid" issue.

In **The Mining World** for July 29th the position of gold mining in the Colar Field of Mysore, India, is reviewed, with copious tabular data. In the issue for the week following, August 5th, gold mining in New Zealand is similarly dealt with, the progress of the same being shown to be steady if not startling.

> A great deal of *bonâ fide* prospecting has lately taken place, and development work is expanding throughout the Colony. Last year's total production of gold and silver was valued at £1,114,000, and that of other minerals, including coal, £1,069 000, as against £1,001,100 and £856,000 respectively. The value of the chief mineral productions for the year 1898 was £2,182,000, this being an increase of £324,000 compared with 1897. The total value of gold, silver, coal, and other minerals exported up to the end of 1898 was £70,767,500. This is a record which goes to prove the really valuable character of the mineral deposits of the Colony, and it is encouraging to find that since the commencement of the current year the output of the precious metal has shown a gratifying, if irregular, augmentation.

The weekly surveys of the Mining Market are most comprehensive, and the reports of the meetings of mining companies form a special feature of the paper. "Unfair Allotments" are dealt with editorially in the issue for August 12th, and the Queensland Mines, with copious statistical data, are exhaustively treated in the same number.

The July number of the **Machinery Market** contains the 51st of the "Notable Establishments" illustrated series of articles which form an important occasional feature of that journal. The works of the Weardale Iron & Coal Co., Ltd., is the subject. Mr. James Marshall, of Messrs. Marshall, Sons & Co., Ltd., is the subject of the usual portrait supplement and biography. The machinery and implements exhibited at the Royal Show at Maidstone are reported in compendious measure. In the August number the portrait and biography given are those of Mr. Henry Bates, the managing director of Messrs. Halse & Co., Ltd., of Salford. A good deal of correspondence appears in the same issue on the subject of the proper time, from various points of view, for opening and closing the "Royal" Show. The first portion of a serial paper on "Recent Developments in Machine Tools," by Mr. Ewart C. Amos, appears, and the other serial articles, which form a regular and interesting feature of the *Machinery Market*, are continued in both the issues mentioned.

The August number of the **Marine Engineer** necessarily devotes much of its space to the proceedings and the papers read at the recent summer meeting of the Institution of Naval Architects. Its record of marine and shipbuilding happenings is abundant, the whole forming an excellent number.

The **Textile Manufacturer** for July 15th is as full as usual of a varied mass of technical and commercial information relative to the textile trades. The serial articles in this journal are one of its most valuable features, and those in the July number include instalments of Professor Beaumont's "Tapestry Weaving and Designing;" Mr. M. M. Buckley's "Worsted Spinning;" Mr. G. Washington's "Effects of Yarn Twist upon Cloth;" "S. B. H.'s" "Common Effects in Woollen and Worsted Cloths;" Mr. J. Russell Wildman's "Sizing of Cotton Goods;" Mr. Taggart's "Practical Details in Spinning Machinery;" Mr. W. N. Twelvetrees' "Drying of Textile Fabrics and Materials," and a number of others besides. The self-contained articles are well up to the usual standard of textile interest, embracing descriptions, in most cases with illustrations, of new textile machines. A pictorially embellished article on a new Italian cotton mill at Busto Arsizo is of special interest, inasmuch as it is declared that "as regards modern equipments, conveniences, and arrangements, it would be difficult to find an equal anywhere else in Italy, and few mills, even in our own country, are so well fitted up with modern machinery and accessories." A paper on "Central Steam Condensing Plants" is also worthy of particular note to many. The "pattern sheets" have become quite an established feature. The "Gleanings from Consular Reports" contain a judiciously selected list of valuable hints from a somewhat neglected branch of official literature; and the issue, as a whole, is of fully average merit, and that is no small praise.

Amongst other subjects dealt with editorially in **The Journal of Gas Lighting** is the administration of the Gas Light and Coke Company, about which so much has recently been heard and written. The proceedings at the half-yearly general meeting of the Company are very fully reported, and will prove of service as a record of a meeting the outcome of which it is difficult to forecast. The concluding instalment of the prize essay on sulphate of ammonia by Mr. James Muir, M.R.A.C., also appears, and the issue con-

tains, as the *Journal* invariably does, a copious budget of news and technical information relating to gas lighting and water supply.

In the **Colliery Guardian** for July 28th the Root principles of ventilation, especially in their relation to the theory of afterdamps, are exhaustively dealt with. It is pointed out that the sum of our knowledge on the subject of afterdamp is very imperfect. The conclusions arrived at are summarised thus :—

> It seems clear that the afterdamp encountered by a party of explorers may frequently be but the last of a series of afterdamps due to a series of explosions; and it appears certain that the possible constituents of such afterdamps include carbonic oxide, carbon dioxide, acetylene, sulphuretted hydrogen, free hydrogen, with a probable proportion of free nitrogen due to the dissociation of certain compounds, and also, of course, more or less atmospheric air. As our methods of investigation become more efficient, this list will probably be extended; but in the meantime, and in the actual presence of afterdamp, the wisest attitude that can be adopted by the mining man is that suggested by the words: "On guard."

In the same issue other subjects treated include "Coal Mining in Sweden" and "Liquid Fuel for Marine Purposes," and illustrated descriptions are given of the Marsaut lamp fed with benzine, a new rope-driven travelling crane, and of a new system of valves for steam engines and air-compressors, both of American design. The issue of the same journal for August 4th contains, amongst a liberal allowance of technical matter, an illustrated article on Coal-mining in Bosnia; another on the discharging of coal at colliery screens, and a communicated contribution from a Saxon engineer on a "Method for the supersession of winding in shafts." The new method described is claimed to be—

> more advantageous than would be a winding engine worked by steam with its accessories, seeing that the useful effect of large pumping engines is always far higher than that of winding engines. . . . The usual danger of a heavy object falling down the shaft does not exist in this case, because the containers move in tubes that are filled with water.

The disposition which prevails on every hand to minimise labour troubles, and the question of the expediency of employing Chinese colliers in British coal mines, are discussed in the leading columns.

The Iron and Steel Trades Journal for July 29th deals in its leading articles with the navy, and with that vexed question the employment of water-tube boilers in H.M. ships, taking on the latter subject a view antagonistic to that of Mr. William Allan, M.P. Another leader deals with the British lead industry, and is intended to illustrate one aspect of the decadence of British lead production. It concludes :—

> In 1876 we imported 80,000 tons of lead, and it cost just £1,750,000. Twenty years later, in 1896, we received more than double the quantity of lead, and it cost us only £100,000 more money. We get 100 per cent. more lead for 5 per cent more money. The "W. B." works have passed away, and lead mining as a British industry has lost its relative importance, but the trade of the country as a whole has lost little and gained much by the change.

"Discounts in the Iron Trade" and "The Iron Famine all 'Bluff'" are further subjects of editorial comment. The issue for August 5th deals in its editorial columns with the subject of copyright and trade marks, based on the recent "Butterfly" brand litigation, in which it declares that :—

> Now we have a leading case, with the issue clearly defined, and it is ruled that there is no copyright in trade-marks. It will be idle in future to register likely trade marks, at a cost of a few pounds, in the hope of reselling at a high figure to someone who has innocently adopted a mark resembling something already on the register, which is not, and has never been, a genuine trade mark in actual use.

In dealing with the question of Chinese miners in British Columbian mines **The Iron and Coal Trades Journal** hopes that the decision at which the Judicial Committee of the Privy Council have arrived "will result in an alteration in the mining laws of British Columbia, and that mine-owners, while they have freedom to choose between white or yellow labour, will not be allowed to mix the two, and will be compelled to employ exclusively either the reckless Chinaman or the more cautious European."

The recent issues of **The Mechanical World** give the usual instalments of the excellent serial technical articles which are a distinguishing feature of this paper. The issue for the 28th July deals for example, in this way, with "Corliss Valves and Gears," "The Design of Beams," and "The Erection of Engines and Shafting." In the same issue a copiously illustrated article appears on "Central Steam Condensing Plants," and another contribution deals with pump failures, which are so frequent a source of annoyance in mining and other practice. *The Mechanical World* for August 4th deals editorially with the water tube boiler question, and is disposed to suspend judgment pending the appearance of the Admiralty report. "The conditions of Merchant Service and the Navy, it maintains, are entirely different, and the circumstances of the two are not comparable." A somewhat controversial article on "Technical Education" for workmen is worth perusal. It contends that "The inference that improved technical education will enable us as a nation to keep the lead in manufactures is not clear; but it deserves inspection." The result of this, from the writer's point of view, seems hardly conclusive, although most will agree that while it is unnecessary that "every workman should be able to investigate the higher mathematics," still "some mental application on the part of a workman after a day of physical toil is really more restful, within limits, than mere idle resting." The serial articles include amongst their subjects, "Moulding a Double Cylinder," and "Electrical Transmission of Power in Mining." Sundry quoted articles are also worthy of careful perusal. The number for August 11th contains an article by Mr. Walter B. Snow on "Possible Economies in Steam Boiler Management," and the serials include instalments of "Modern Engineering Workshop Practice," and "Condensers for

Electric Light and Power Stations." Each of these issues contains a number of useful abstracts and condensations of papers read before technical societies.

In the **Electrical Review** for July 28th some recent advances in American electro-medical apparatus are illustrated and described, and prominence is given to an article on the Westinghouse Gas Engines, which are at present attracting so much attention in engineering circles. A special illustrated description of the Dudley and Stourbridge Electric Tramways is perhaps the principal feature of the issue. A serial paper, by Mr. E. C. Amos, on machine tools is continued in this and succeeding issue, and another serial on "Installation Expenses" runs through these two numbers and is concluded in the issue of the 11th August. A searching criticism on the policy and the recent half-yearly meeting of the Eastern Telegraph Company appears in the issue of July 28th, and a useful article on "Continuous Power Meters." In the issue of the same journal for August 4th there is a leader on "Direct Coupled Plants," which is mainly a criticism of the views and recommendations made by Mr. J. B. Stanward before a recent meeting of the American Society of Mechanical Engineers; and deals especially with the expediency or otherwise of limiting the size of high speed engines. The out-and-out advocates of slow speed engines find little sympathy in that article; and it adds:—

> It is said occasionally that a high speed engine is all very well as long as nothing goes wrong, but it is difficult to see wherein it differs from other engines. Not long ago it became a well-known axiom in American electricity works employing slow speed engines to retreat behind a pillar and await developments whenever the engine reached a certain speed. That the precaution was not wholly unnecessary was shown by the occasional bursting of heavy fly-wheels.

The Barrow-in-Furness Electricity Works is the subject of an illustrated descriptive article in the same issue, and a serial paper on the "Indispensable Accessories of Electric Traction" is continued. In the issue for August 11th there is a leader on "Electric Traction Progress in London," in which it remarks:—

> There are rumours of a proposed outlay of a million sterling very shortly. We hope there is truth in the rumour, and that the London Council, which exercises its influence in so autocratic a fashion in labour clauses on behalf of the British workman, will see that English contractors are allowed to carry out the greater share of the work in English electrical factories, thereby benefiting the electrical industry of this country, and, in consequence, the workmen engaged therein.

In the same number there are an instalment of the paper on "Return Feeders for Electric Railways," and a special illustrated article on the "Plymouth Lighting of Tramways." Each issue contains a voluminous mass of news and information which are more or less indispensable to those engaged either in the technical or commercial aspects of electrical engineering.

In the **Laundry Record** for July Mr. John Taylor's articles on "The Steam Laundry: its Construction and Equipment," and on "The Management of a Steam Laundry," are continued; in the latter case the subjects treated, which are dealt with in practical fashion, being the drying, folding and preparing, and ironing of laundry goods. The proceedings of the National Laundry Trade Protection Association's meetings are always fully reported in this journal, and the account of the June meeting occupies a prominent position in the issue under notice. The same may be said regarding the Northern Counties Laundry Association. The general news of the laundry trades is copiously given. The journal's portrait gallery presents an excellent portrait of Mr. John T. Mason, Vice-President of the National Laundry Trade Protection Association, Ltd. In the August number the portrait being that of Mr. R. W. Barber, also vice-president of the same body. The serial articles already mentioned are again advanced a stage, packing and the management of boilers being subjects treated under "Management" series. The several Associations' proceedings are again fully reported, and the trade news of the month carefully summarised.

AMERICAN.

In the July number of the **Engineering Magazine**, Mr. Charles Rous-Marten commences a series of articles on English and American locomotive-building (continued also in the August number) which should serve a useful purpose in correcting mistakes which are current regarding the respective working value of English and American engines. Messrs. Gardner C. Sims and William S. Aldrich deal with the work of the American naval repair ship *Vulcan* in raising the sunken Spanish warships, and Mr. H. M. Chance with the increasing production of gold. An excellent article on "Machine-shop Management in Europe and America," and formulating the elements of a standard machine works design, is contributed by Mr. H. F. L. Orcutt. Mr. George Lieckfeld has a paper on "The Evolution and Future of the Gas Engine," giving quite an optimistic estimate of its economy and possibilities as a motive agent. In another article on "The Efficiencies of Modern Steam Boilers and Furnaces," Mr. R. S. Hale explains the ways and means of transferring the maximum of heat from fuel to steam. There are several other interesting papers. In the August number of the same Magazine there is an informatory article from the pen of Mr. Rudolph Haack on the development of German shipbuilding, indicating the enormous progress made in that industry by Germany since the consolidation of the empire. Mr. Orcutt's serial article is continued. Mr. H. Emerson deals with the success of the opening up of the Alaskan transportation routes. Mr. Enrico Bignami, an Italian electrical engineer of repute, explains how the utilisation of the available water powers of Italy may prove the industrial salvation of a country poor in coal. Dr. F. H. Hatch, an English mining engineer, in an article on "The Transvaal Mines and the Boer Government," states the case for the Uitlander mining engineer, and Mr. George Lieckfeld has a

paper on the "Evolution and Future of Benzine and Petroleum Motors." Both are excellent numbers, copiously illustrated.

The July number of **Cassier's Magazine** is quite up to the high standard of excellence, both from literary and pictorial standpoints, which is characteristic of this periodical. The premier place in the contents is given to an able, exhaustive and very informatory article on "The Strength of the British Navy," by Mr. Archibald S. Hurd. Every aspect of the question seems embraced in the review, and it is embellished with numerous illustrations of typical ships. Our fleet of 489 vessels represents the colossal initial outlay involved of £108,000,000, which the author describes as being "a part of the funded capital of Great Britain's formidable system of insurance against a foreign foe." Mr. Walter Dixon, M.Inst.C.E., deals with "Some Conditions of the American Iron and Steel Industries," and the Hon. C. K. Parsons with the "Development of the Steam Turbine"—a paper which will repay careful perusal. Another important contribution is that by Mr. S. Dana Greene, on the increasing application of electricity to marine work in the United States. The vexed question of "Depreciation" is thoughtfully treated by Mr. Joseph Nasmith, and of great interest is "The Story of Smokeless Powder," as told by Mr. Hudson Maxim. Several other papers make up a capital number.

Power for August contains its usual massive budget of copiously illustrated technical matter. Amongst other articles worth perusal are those on "Coal Storage and the Mechanical Handling of Coal," the Hill automatic engine, and Leffel automatic cut-off engine.

The principal feature of **The Engineer** for August 1st is an illustrated article on Long-Distance Transmission and Uses of Electricity." The "Energizer Momentum Engine," of which some brief account appeared in our "Industrial Progress" columns last month, is made the subject of a leader, described as "another fake" and severely handled.

The **American Manufacturer**, July 27th, has several useful papers, in particular a fully illustrated one on Cargo Handling Machinery at Lake Erie Ports. The same journal for August 3rd gives prominence in an article on Superheated Steam to Hering's apparatus.

The **Electrical Review** of July 26th gives prominence to an article on Irrigation by Electricity. The issue for the week following reprints a thoughtful paper for the Year Book of the Society of Engineers, University of Minnesota, on "Methods of Transmitting Intelligence by Cable," the same subject being dealt with editorially in a leader.

CONTINENTAL.

The Revista Minera, in reviewing the Bilbao directory, just published, states that a Spanish engineer, Senor Palacio, has invented a loading bridge known as the "Biscay Loader," which it has been decided to adopt on both banks of the Clyde. The *Revista Minera* says this is one of the rare Spanish inventions that have won admiration in foreign lands.

In the issue of **La Nature,** 12th August, G. Pelissier shows that the application of petroleum to the regulation of acetylene generation is not new. Schneider patented it in 1895. Then M. d'Arsonval similarly anticipated the notice of Mr. Leroy. Even two Belgians, Claude and Hess, were in advance of Mr. Leroy. Another way is to attack the carbide by an agent less active than water, as proposed by Chassevant. Mr. Bullier prefers "eau sucrée, etc." Many are the inventors in connection with the new gas. Hence this warning as to what has been done.

The Revue Industrielle, 5th August, leads off with a description of the Gengembre system of freeing oil from raw material by means of spirit, instead of pressure. As practically every detail of the process has been in operation in England over 20 years, the *Revue Industrielle* may be said to have got hold of an Industrial Chestnut. In the same issue it illustrates an ingenious system of mechanical weighing. The 29th July issue illustrates a mechanism for taking diagrams of a steam piston's work.

Stahl und Eisen for 1st July describes the launch from the Kiel yard of the armour-plated *Kaiser Wilhelm der Grosse*. Length, 115 metres; breadth, 20·4 metres: displacement, 11,130 tons; h.p. 13,000; speed, 18 knots. An illustrated description of two 10,000,000 kilogrammes power forge presses, made by Breuers of Kalk, and a two-page table of the world's railways. The issue for the 15th July contains a full illustrated description of the Ras el Maden iron mines, Algiers. An interesting notice on Austria's iron industry during the last 50 years, and a pretty full statement of German imports and exports to 31st May in ores and metal goods.

Le Génie Civil for the 29th July gives the report of the Committee appointed *re* the Heavy Auto-car Competition in France, August, 1898. It is very interesting. Speed was a second or third consideration. Durability, negociation of difficult roads, cost of fuel, etc., all meant points in the competition.

L'Industrie of the 13th August exhaustively treats on mechanical tramway traction in Madrid, and follows the "Mechanical World" with a treatise on the simplification of the Electrical Unit.

Die Mühle.—The issue for the 11th August states that the second pneumatic grain unloading apparatus for the Hamburg-America line has just been launched. The float is sharp fore and aft and measures 36 × 9 × 4·25 mètres. It is divided into six water-tight compartments. It carries no self-propelling power. It only carries the grain-moving apparatus, consisting of a 250 h.p. engine which works two double-action cylinder air-pumps. These create sufficient vacuum in the suction tubes to allow 150 tons of grain per hour to be pressed out of the ship's hold. The grain is automatically weighed as it passes on to the rail or street cars—as the case may be.

REVIEWS OF BOOKS AND CATALOGUES...

CABLE CODES UP TO DATE.

The General Commercial and Mining Telegram Code, by C. Algernon Moreing, M.Inst.C.E., F.G.S., and Frederic G. McCutcheon. London: William Clowes & Sons, Ltd., 13, Charing Cross, S.W.

The Premier Code, by W. H. Hawke. London: Effingham Wilson, 11, Royal Exchange, E.C.

100,000-Word Supplement to The Premier Code. London: Effingham Wilson, 11, Royal Exchange, E.C.

With the ever-increasing amount of telegraphic cable communication which the business and social requirements of the times demand, and the consequent multiplication of cables, it is not surprising to find that the making of codes has offered attractions, remunerative and otherwise, to quite a number of authors. Whereas a few years ago the really useful, comprehensive, and reliable codes available could be numbered on the fingers of one hand, there are now quite an exhaustive list of special and general ones, representing in many cases a high standard of compilation and a vast amount of skill and labour. This is a matter for congratulation, for anything that is calculated to facilitate inter-communication between this and other countries, and especially with our colonies and dependencies, advances the cause of civilization and peace, and promotes material prosperity. We therefore welcome the appearance of two additions to the number of existing codes, more particularly as they show in many respects advances upon those which have preceded them.

A code which most favourably impresses the critical examiner, alike on the grounds of comprehensiveness and clearness, is ***The General Commercial and Mining Telegram Code,*** the joint work of Mr. C. Algernon Moreing, the well-known civil and mining engineer, whose name has, in the past, been favourably associated with code compilation, and Mr. Frederic G. McCutcheon, who will be remembered as the author of several codes. The compendious character of this work will be understood when we say that it comprises no less than 274,000 words and phrases, and these have been selected with evident care and arranged for use upon a sensible grammatical basis as well as upon an analytical plan. By this means phrases and parts of phrases are made available at once in such a form that, when they are employed in combination, the result is grammatically correct and sequential sentences, which enable communications to be made with an increased degree of clearness and a minimum of liability to error. There is thus provided in the code not only pre-arranged and fixed separate phrases and sentences, which are complete as they are found in the work, but also a systematic method of forming other sentences by the use of successive combinations of words or partial phrases which find places in the code. If one takes as an example the word "property," it is found that all the sentences, or parts of sentences, which have reference to property are conveniently arranged on alphabetical principles, and also upon a plan which immediately appeals to the intelligence of the user, enabling him to complete the combination he requires with the least amount of time and trouble. The facilities for drafting a message are increased by an index to the most important words in the English language, which is so arranged as to assist the compiler of a message in finding the word or phrase which most clearly conveys the interpretation desired. This index resolves itself practically into a dictionary of synonyms, just as, indeed, the code as a whole is a commercial and technical phrase-book on a large scale. Another feature is the combination tables for transmitting the name of any twenty-five stocks or shares, with phrase, price, quantity, and so forth. There is also given the official vocabulary of cipher words, prepared in accordance with the decisions of the International Telegraph Conference of Paris. While easily one of the most exhaustive codes which we have yet seen, Messrs. Moreing and McCutcheon's work is kept within reasonable bounds as to size, being royal 8vo., and its 2,500 pages are clearly printed on bank-note paper. The authors may well be congratulated on the complete success of the enormous amount of labour involved. The code is not dear at the £5 5s. charged for it.

Another code which will commend itself to those who have much telegraphic communication to make is ***The Premier Code,*** compiled by Mr. William H. Hawke. It also is on a scale of relative completeness, and it is claimed that by the method of its arrangement a saving of from 50 to 80 per cent. in the cost of messages may be effected by its use. However this may be, and we have not experimented so far as to be able to form an opinion as to the validity of that claim, no inconsiderable amount of originality has been employed in planning the general scheme of the arrangement. This is based upon what, so far as we know, is an entirely novel principle, and yet the method of tabulation employed is simple and readily grasped. One portion of the work consists of phrases in alphabetical order; then a number of pages follow with blanks for phrases that the user may require for his own purposes; and a third, and the largest, portion of the work comprises tables incorporating the whole of the English language ordinarily employed in business and social communications, besides a number of other useful tabulated matter.

The original volume has been rendered more valuable still by the issue of a ***100,000-Word Supplement,*** by means of which communications may be transmitted with secrecy, and the use of plain language, while, should plain language be necessary in the course of a message, a catchword indicates how many words are plain. The catchwords are also arranged so as to bring in the use of other codes when necessary in dealing with special subjects, such as engineering, mining, and the like. For its size and utility this code is remarkably low priced at 10s. 6d. per volume.

Concerning "Feilden's Magazine."

Unanimous approval from great Authorities, . . leading Engineers, representative British Firms, and the Press of the United Kingdom. . . . . .

It would be a Herculean task to attempt to discriminate between the hundreds of letters and press notices we have received. We give on this and the following page a few instances, typical of a great number, which will serve to convey some idea of what is generally thought of our Magazine throughout the United Kingdom and Abroad.

Sir W. H. Preece, K.C.B., F.R.S., writes:
"I admire the get-up very much, and I hope you will reap the reward of your enterprise."

Hobart Bird, Esq., M.I.M.E., says:—
"I do not think there is room for much difference of opinion respecting FEILDEN'S MAGAZINE, and it appears to me to fill a want very distinctly felt hitherto by those of us who, provided the quality be not inferior, always prefer the British to the imported article. I heartily congratulate you on your most excellent Magazine; the contents are sound and interesting; the paper, type, &c., are beyond all praise; and your motto, 'Militantly British,' is capital. May you have the success you so well deserve!"

J. Rostern, Esq., Assistant General Manager of the Great Central Railway, writes:—
"The Magazine has certainly exceeded my expectations."

Harry Pollitt, Esq., Locomotive Superintendent of the same Railway, says he was greatly interested in its very excellent contents.

Almost without exception our advertisers have returned unanimous appreciation. Here are one or two:—

Messrs. Fleming, Birkby & Goodall write us:—
"We hasten to compliment you on the eminent success of your inaugural Number, and we venture to predict for your Magazine a very high place in commercial journalism if you are able to maintain the high standard with which you have commenced. The printing is good: the illustrations—many of them superb—are all excellent: the paper and general get-up are also first-class: the cover, too, is unique, original and attention-arresting. . . . the articles . . . are in keeping with the otherwise superior character of the Magazine. We especially admire your striking motto 'Militantly British' and hope you will be able to maintain the aim and purpose of so desirable a watch-word throughout—what we trust will be—the protracted career of FEILDEN'S MAGAZINE."

Messrs. John Davis & Son consider
"It is in advance of any of its competitors."

Messrs. T. Coulthard & Co. say:—
"The Magazine is being very much praised."

Messrs. Matthews & Yates consider that
"Both in literary matter, illustrations, and in general arrangement it is excellent."

The Williams Typewriter Co. for Europe say that while they expected to see something good, it exceeds their expectations.
"It is certainly a beautiful book, and a credit to any country."

Many others are in the same strain.

The Secretary of the Newport Chamber of Commerce is of opinion that it is
"The most up-to-date production which has yet been brought out within the domain of technical Magazines."

The Librarian of the Coventry Free Library says:—
"It is a most valuable contribution to contemporary technical literature."

SEE NEXT PAGE.

Some few opinions out of hundreds from the daily Press on "Feilden's Magazine."

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The Daily Mail (London), in an article headed "Stands England where she did?" says :—

"The publication of FEILDEN'S MAGAZINE marks a new epoch in the history of technical publications. It deserves to rank with the best produced."

The Daily News (London) says :—

"The promoters are evidently determined that Britain is neither to be beaten in engineering nor in the efficiency of its trade and technical publications."

The London Sun concludes a remarkable article by saying :—

"There is nothing like it, or approaching it, in British engineering journalism. Its value to the engineering industry of the country can scarcely be over-estimated."

The Manchester Courier says :—

"Well written, well printed on good paper, with excellent illustrations, it is a worthy rival of the American industrial magazines, which have hitherto 'held the field.'"

The Sheffield Daily Telegraph says :—

"It is gratifying to learn that the whole of the issue of the first number was sold immediately after it was put on the market. The number has had to be reprinted since to satisfy the demand."

The Newcastle Leader devotes its principal leader to our motto "Militantly British," in the course of which it says :—

"For the artistic beauty of its illustrations, and for the variety and quality of its articles, it has no equal in England, and is on a level with the best works of the kind in the United States."

The Scotsman observes :—

"It follows the well-defined policy of furthering the particular interests of British engineering—a circumstance which, no less than the substantial merits of its contributions, must recommend it strongly to readers of technical literature throughout the world."

The Belfast News Letter says that the Magazine "could scarcely be improved."

The Edinburgh Evening News observes, in a leaderette :—

"The country's eyes are being opened to the dangers of our position. The first issue of FEILDEN'S MAGAZINE boldly declares itself to be 'Militantly British,' but it is 'the Imperialism of Commerce and Kinship, not of Militarism.'"

The Northern Whig (Ireland) says :—

"This high-class, representative, all-British engineering Magazine is certainly of very striking merit and full of splendid promise."

The British and Colonial Printer:

"It reaches the high-water mark of excellence."

Iron and Steel Trades Journal informs its readers that :—

"Mr. Theo. Feilden has in the past been identified with the production of trade papers which have been almost works of art; and in design, colouring, and general appearance, FEILDEN'S MAGAZINE is a thing of beauty."

The Nautical Gazette (New York) :

"FEILDEN'S MAGAZINE is a success. It will be an eye-opener for Englishmen, but it will be worth a great deal to them."

The first issue of ***Feilden's Magazine*** contained among nearly 200 pages of other valuable matter, the following original articles by experts, specially contributed :

The Engineering Conference, 1899. Sir W. H. Preece, K.C.B., F.R.S.

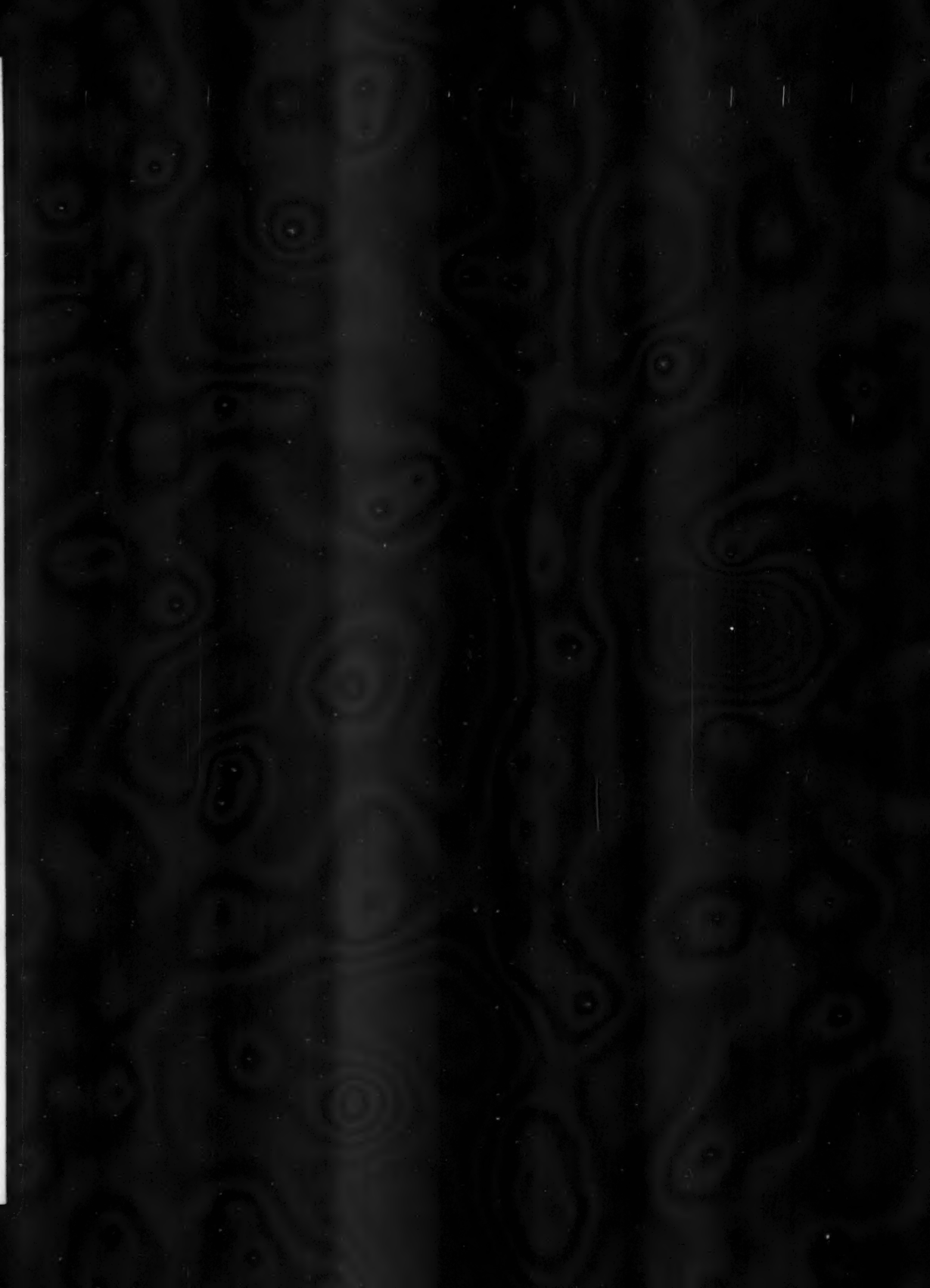
Recent Characteristics of British Locomotive Engineering. C. Rous-Marten.

Acetylene Generators. Prof. Vivian B. Lewes.

The Iron Making Blast Furnace as an Ideal Power Producer. Horace Allen, C.E.

An Electrolytic Process for the Manufacture of Parabolic Reflectors for Searchlights and Locomotive Headlights. Sherard Cowper-Coles, M.I.M.E., etc.

Machine Tools. Ewart C. Amos, M.I.M.E.

Copper Steam Pipes. W. Edward Storey.

Owing to the exceptional demand for the issue, we can now only supply copies of No. 1 at 2/- each. Those desirous of commencing their Annual Subscriptions, to include No. 1, must therefore remit 11/-.